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REPORT

ON THE

SCIENTIFIC RESULTS

OF THE

VOYAGE OF H.M.S. CHALLENGER

DURING THE YEARS 1873-76

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ZOOLOGY—VOL. X.

PART XXIX.—REPORT ON THE HUMAN SKELETONS—THE CRANIA

BY WM. TURNER, M.B., LL.D., F.R.SS. L. & E.

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EDITORIAL NOTE.

This Paper is the first part of a Report, by Professor William Turner, F.R.S., on the Bones of the Human Skeletons collected by the Expedition, and deals with the Crania. Professor Turner has not limited the Report to a description of the Crania actually collected by the Expedition, but has examined along with them numerous skulls from other collections, and has drawn certain general conclusions bearing on the Ethnology of the races. The Manuscript containing the descriptions of the Crania was received in July 1883, whilst the last two chapters referring to the general conclusions were received in July 1884.

John Murray.

Challenger Office, 32 Queen Street,
Edinburgh, 24*th September* 1884.

THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY.

REPORT on the HUMAN CRANIA AND OTHER BONES OF THE SKELETONS collected during the Voyage of H.M.S. Challenger, in the years 1873–1876. By WILLIAM TURNER, M.B., LL.D., F.R.SS. L. & E., Professor of Anatomy in the University of Edinburgh, Foreign Member of the Anthropological Society of Paris.

PART I.—THE CRANIA.

DURING the voyage of H.M.S. Challenger Human Crania and Skeletons were collected at several of the ports at which the ship called. These were entrusted to me by Sir C. Wyville Thomson on the return of the expedition. They consisted of specimens from the following localities:—

The Admiralty Islands,
Hawaii, Sandwich Islands,
Oahu, Sandwich Islands,
Chatham Islands,
New Zealand,
Australia,
Tierra del Fuego,
Patagonia,
Bush Race, from South Africa.

In this part the Crania only are described. The other bones will form the subject of a short second part in a subsequent volume.

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HUMAN CRANIA.

INTRODUCTION.

In the description of these crania I have to a large extent adopted the terms and craniometrical methods introduced by the late M. Paul Broca, which have contributed so much to give exactness to craniological research. It is not necessary that I should enter here into any detailed explanation of the meaning of the terms which he has proposed with so much advantage. For not only are they amply defined in his own writings, more especially in his well-known Instructions Craniologiques et Craniometriques,[1] but a sufficient explanation of them is furnished to all English readers in the translation of Dr. Topinard's Anthropologie,[2] and in Prof. Flower's Catalogue of the Human Crania in the Museum of the Royal College of Surgeons of England.[3]

It will, however, be advisable to say a few words about some of the craniometrical methods which I have employed. For unfortunately there are in use by craniologists so many different ways of measuring even the principal dimensions of the skull, that it becomes necessary for each investigator to preface his description by stating the method that he has himself pursued.

As it is important in all craniological enquiries to obtain an average from as large a number of specimens as possible, I have not restricted myself to the examination and mensuration of the skulls collected during the voyage of the Challenger; but have, whenever practicable, studied along with them skulls from the same localities, preserved either in the Edinburgh University Anatomical Museum or in other collections in this city. This Report has therefore become an essay on the craniology of certain Races of Men.

The measurements have been made with instruments supplied by M. Mathieu of Paris. They are recorded in millimètres. In calculating the indices when the fraction was below ·5 I have not taken it into account. When ·5 or above ·5, I have either stated it or given the benefit of the fraction to the preceding whole number.

In each table of measurements I have recorded the length both from the most projecting mid-occipital point to the ophryon, and from the mid-occipital point to the most prominent part of the glabella. I have not thought it necessary specially to record

[1] Paris, 1875.

[2] Translated by Dr. R. T. H. Bartley. Library of Contemporary Science, London, 1878.

[3] London, 1879.

the diameter from the mid-occipital point to the fronto-nasal suture (nasion), which is the dimension taken by Professors van der Hoeven,[1] Cleland[2] and Virchow,[3] for I find that as a rule it approximates to the ophryo-occipital diameter. In many specimens, more especially in female skulls, the difference between the ophryo-occipital, nasio-occipital and glabello-occipital diameters, does not amount to more than two or three millimètres, and it is only when a great development of the frontal air-sinuses and of the glabella takes place, that the difference in these three diameters becomes very distinctly marked.

The greatest breadth recorded in the table is taken in the parietal or parieto-squamous region, wherever it occurs, and the letters *p* and *s* appended to the measurement express whether this maximum breadth be situated at or near the parietal eminence, or at or near the parieto-squamous suture. The greatest breadth and the glabello-occipital diameter have been taken therefore in the manner proposed by the illustrious Retzius,[4] the founder of scientific craniometry.

The length-breadth or cephalic-index has been calculated from the relations between the greatest breadth and the glabello-occipital length,[5] but those craniologists who desire to take the ophryo-occipital length as the basis of their calculation have the data furnished in the tables. I have preferred the glabello-occipital length as a basis for calculating the cephalic index, rather than the ophryo-occipital diameter, which has been adopted by Dr. Barnard Davis[6] and by Professors Rolleston[7] and Flower.[8] For the ophryon has not the same definite position as the glabella, and observers do not always agree in localising the ophryon at the same point on a skull. To ignore the glabella in estimating the extreme length of the cranium, is to leave out of consideration an eminence which in many skulls and heads constitutes one of the most noticeable features in the frontal region, and which is so frequently an important sexual character. Moreover, it seems to me that with the skull as with the living head, our object should be to compare the greatest length and greatest breadth with each other wherever they occur, and not to confine our measurements to those parts of the skull which more directly form the wall of the brain cavity.

I have arranged the crania according to the proportions of length and breadth into three categories and have adopted M. Broca's term mesaticephalic, to express a group between the dolichocephalic and brachycephalic types of skull.

I have not thought it necessary to adopt those minor subdivisions of sub-dolichocephalic

[1] Catalogus craniorum diversarium gentium, Leyden, 1860.

[2] Variations of the human skull, &c., *Phil. Trans.*, 1869.

[3] *Archiv für Anthropologie*, vol. iv. p. 59, 1870.

[4] Müllers *Archiv*, 1845, p. 126, and Ethnologische Schriften, pp. 24–166.

[5] The glabello-occipital length is merely another mode of expressing the diameter subsequently named by M. Broca, the antero-posterior maximum.

[6] Although Dr. Davis states that his measurement is taken from the glabella, yet as he regards that "as about an inch above the fronto-nasal suture," it obviously approximates closely to the ophryon.

[7] British Barrows, p. 560, 1877, and collected Scientific Papers and Addresses edited by Prof. Turner, p. 165, Oxford, 1884.

[8] Catalogue of Human Crania, p. xvii. 1879.

and sub-brachycephalic which M. Broca,[1] and Dr. Thurnam,[2] have employed, or a somewhat similar series of terms suggested by Prof. Huxley;[3] for, however interesting such subdivisions may be in recording the indices of individual skulls, they are really of little practical value in expressing differences of race; and by giving an appearance of minute accuracy under conditions which are variable within certain limits, they are apt to give an importance to groups, the numerical limits of which are quite arbitrary, greater than they actually possess. The numbers which I have employed to mark the limits of each of the three groups are similar to those used by Prof. Flower:—*e.g.*, Dolichocephalic, below 75; Mesaticephalic, 75 to 80; Brachycephalic, above 80.

The vertical or altitudinal index has been calculated from the relations between the basi-bregmatic height and the glabello-occipital length. It is, therefore, an expression of the relation of length to height. Data for calculating the relation of breadth to height and of forming therefore a breadth-height index, are provided in the tables. The terms platycephalic or tapeinocephalic have been suggested by various craniologists, to indicate skulls with a low vertical index, and akrocephalic or hypsicephalic[4] to express those whose index is high. For skulls of intermediate or moderate altitude I have used the term metriocephalic. The following classification of skulls in accordance with the relations of length and height is adopted in this Report:—Tapeinocephalic, below 72; Metriocephalic, between 72 and 77; Akrocephalic, above 77.[5]

The minimum frontal, stephanic, and asterionic diameters have been taken according to the methods prescribed by M. Broca. In many instances, though not in all, the stephanic diameter gives the greatest diameter in the region of the frontal bone.

The horizontal circumference has been obtained with a graduated tape line, by measuring from the most projecting part of the glabella around the occipital point back to the glabella. The total longitudinal arc is the distance in a curved line from the nasion over the vertex, to the opisthion, and the proportions contributed to this arc by the frontal, parietal, and occipital bones respectively, are also stated. The vertical transverse arc is measured from the supra-auricular point over the bregma to the corresponding

[1] *Bulletins de la Société d'Anthropologie*, t. i. p. 507, 1861; La classification et la nomenclature craniologiques in *Revue d'Anthropologie*, t. i. p. 385, 1872.

[2] Ancient British and Gaulish Skulls, *Memoirs of the Anthropological Society of London*, vol. i. 1865.

[3] Prehistoric Remains of Caithness, p. 85, 1866.

[4] M. M. de Quatrefages and Hamy (Crania Ethnica, *passim*) call a skull hypsistenocephalic when the vertical index is higher than the cephalic index.

[5] In a recent number of the *Archiv für Anthropologie*, Bd. xv., 1st and 2nd Vierteljahrsheft, 1884, published after the above Report was in type, Professors Kollmann, Ranke and Virchow in recommending certain terms and methods to be employed by craniologists suggest the following to express the altitudinal index; Chamæcephalic (flat skulls) up to 70·; Orthocephalic from 70·1 to 75·; Hypsicephalic (high skulls) 75·1 and upwards. The term metriocephalic, which I have suggested in the text is, I would submit, to be preferred to that of orthocephalic, because it expresses like the well known terms mesaticephalic and mesocephalic, a form intermediate between two extremes (*μέτριος* moderate), whilst the word *ὀρθός* has no special relation to this intermediate index. Besides the term orthocephalic had previously been used by Prof. Welcker to express the *breadth* index of a group of skulls intermediate between the dolichocephalic and brachycephalic.

point on the opposite side. I have not thought it necessary to give the inferior measurement below the base of the skull between the two supra-auricular points.

I have determined the relative projection of the zygomatic arches as compared with the transverse diameter of the cranium, by placing the skull, without the lower jaw, on a low table, resting it on the teeth and the most depending parts behind. Then, standing erect, I have looked down on the vertex with the right eye directed to the bregma and with the left closed. The terms phænozygous and cryptozygous employed by Mr. Busk have been used to express whether, from this point of view, the zygomata were visible or invisible.

The basi-nasal and basi-alveolar diameters have been taken from the basion, in the one case to the nasion, in the other to the alveolar point, and the gnathic index has been calculated from the $\frac{\text{basi-alveolar length} \times 100}{\text{basi-nasal length}}$. The classification employed by Flower into Orthognathous below 98; Mesognathous from 98 to 103; Prognathous above 103 has been adopted. The basion has therefore been taken as an important central point for determining the length in a straight line from it to the alveolar point, the nasion, and the bregma.

The length of the foramen magnum from basion to opisthion is given. This measurement, along with the basi-nasal length, and the longitudinal arc, also recorded in the tables, will enable the entire circumference of the cranial box mesially and antero-posteriorly to be computed.

The interzygomatic breadth is the distance between the most projecting parts of the zygomatic arches. The intermalar breadth has been taken on a line with the hinder border of the orbital process. The ophryo-alveolar length is measured from the ophryon to the alveolar point, and the naso-alveolar length from the nasion to the same point. The facial index expresses, according to the method of Broca, the relations of the interzygomatic breadth to the ophryo-alveolar length, and is arrived at by the following formula: $\frac{\text{Ophryo-alveolar length} \times 100}{\text{Bizygomatic diameter}}$. I do not attach much importance to a facial index based upon the ophryo-alveolar length; partly on account of the imperfect definition of the ophryon, and partly because the lower jaw is left out of consideration in the determination of the length of the face. The nasal and orbital measurements, with their respective indices, have been taken according to the methods of M. Broca, and the classification employed by Broca and by Flower has been adopted: *e.g.*, Nasal index, Leptorhine, below 48; Mesorhine, from 48 to 53; Platyrhine, above 53: Orbital index, Microseme, below 84; Mesoseme, from 84 to 89; Megaseme, above 89.

Professor Broca also estimated[1] the dimensions of the hard palate without including the dentary arcade. Professor Flower modified and improved these measurements by

[1] Instructions Craniologiques, p. 77.

including the dentary arcade along with the hard palate.[1] He makes the length of the palate to extend from the alveolar point to a line drawn across the hinder borders of the maxillary bones, and its width between the outer borders of the alveolar arch immediately above the middle of the second molar tooth. Instead, however, of using the terms maxillary length, width, and index, which Professor Flower employs, I prefer to call these measurements palato-maxillary[2] or palato-alveolar, as expressing more precisely their nature. As considerable differences exist in the relative length and breadth of the palato-maxillaries in different individuals, it is advisable to have descriptive terms to express the different value of the palato-maxillary index. To follow the rule pursued by craniologists, terms compounded of Greek words should be employed. As οὐρανὸς signifies the vault or roof of the mouth, the term Dolichuranic would indicate a palato-alveolar region where the length is to the breadth proportionally great, so that the roof of the mouth is elongated, and Brachyuranic would express the opposite condition, in which the roof of the mouth approaches more to the semi-circular in form; whilst Mesuranic would of course indicate a region intermediate in its proportions. The Latin terms longi-palatal, brevi-palatal, and medio-palatal would be equally appropriate. The following classification, based on differences in the palato-alveolar region, has been introduced into the Report:—Dolichuranic, index below 110; Mesuranic, between 110 and 115; Brachyuranic above 115.

The measurements of the lower jaw scarcely require any explanation, but I may state that the breadth of the ascending ramus is its antero-posterior diameter on a line with the alveolar border.

In determining the age of a skull, I have relied on the condition of the sutures and on the dentition. When the sutures of the cranial vault were ossified, both in the inner and outer tables, and when the teeth were either much worn down or shed, and the sockets absorbed, the skull is then said to be "aged." When the teeth were all erupted, except perhaps one or two of the wisdoms, and either slightly or moderately worn, and the sutures either unossified or only partially obliterated, the skull is called "adult." The age of the skull in childhood and youth has been arrived at by observation of the state of the milk and permanent dentition.

In determining the sex I have relied, in the comparison of the skulls of each race, on the greater size, weight and capacity, on the projection of the glabella, supraciliary ridges, mastoid processes, inion, and superior curved occipital line, and on a more backward slope of the frontal region as characteristic of male skulls. Whilst a more feeble development of the ridges and projections which mark the position of air-sinuses and attachment of muscles; smaller size and capacity; a fuller occipital squama as compared with the inion

[1] Cranial characters of natives of Fiji Islands, *Journ. of Anthrop. Inst.*, Nov. 1880.

[2] See abstract of my communication on the Crania of the Admiralty Islanders, *Trans. International Medical Congress*, vol. i. p. 146, 1881, and in *Journ. Anat. and Phys.*, vol. xvi. p. 135.

and curved line; a more vertical forehead, a greater flattening of the vertex and consequently a diminished height of the skull, with frequently, though not invariably, a greater breadth of the cranium in the region of the parietal eminences than near the squamous suture, have been regarded as characteristic of female skulls.[1]

A careful enquiry into these different characters will, without much difficulty, enable the craniologist to pronounce definitely as to the sex of a large proportion of the human crania which may be submitted to him for examination. But in large collections of skulls there are always specimens the characters of which are not sufficiently pronounced to enable one to state with certainty to which sex they had belonged. Various specimens of this kind have been distinguished in the tables which accompany this memoir by a query.

In determining several of the indices I have in many instances been saved the labour of calculation by employing the very useful tables which Professor Flower has appended to his catalogue of the human crania in the Museum of the Royal College of Surgeons of England.[2]

The determination of the internal or cubic capacity of the cranial cavity, so as to ensure accuracy and uniformity in result is admittedly one of the most difficult measurements to be undertaken by the craniographer. The amount of shot, or sand, or glass beads, or seeds of different kinds which a skull can contain varies, as has been pointed out, especially by M. Broca,[3] Dr. Wyman,[4] M. Topinard,[5] and Dr. E. Schmidt,[6] with the size of the particles, with the dimensions of the funnel through which they are poured into the cranial cavity, with the rapidity of their flow, and with the extent to which the skull is shaken and the particles made to subside and be compacted together. In a similar manner, the estimation of the amount of the material poured into a skull varies with the height of the cubic measure, with the rate at which the substance is poured into the measure, and with the amount of succussion to which it is subjected. M. Broca strove to give uniformity to the guaging and cubage of a skull by always employing shot of a definite size (No. 8), by pouring it through a funnel, the neck of which had a narrow diameter, and by ramming the shot when in the skull so as to ensure the closest possible approximation of the particles. The shot was then emptied from the skull into measures of a definite height, with the aid of a funnel having a neck of a particular diameter.

[1] M. Broca's Instructions Craniologiques, already cited, and Prof. Ecker's article in *Archiv für Anthropologie*, Bd. i. p. 83, may be consulted with great advantage on the sexual characters of crania.

[2] Professor Welcker has also given in the *Archiv für Anthropologie*, Bd. iii. Heft 3, excellent tables for the determination of the indices of breadth and height.

[3] *Mém. de la Soc. d'Anthropologie de Paris*, sér. 2, t. i. p. 63, 1872, also t. ii. p. 1 ; and Instructions Craniologiques.

[4] Observations on Crania, *Proc. Boston Soc. Nat. Hist.*, vol. xi., April, 1868.

[5] Anthropology, English translation, p. 226, and more fully in *Revue d'Anthropologie*, t. v. p. 385, 1882. I wish to express my obligations to M. Paul Topinard for the interesting demonstration which he gave me of the mode of using M. Broca's method for obtaining the cubic capacity and the precautions which it is necessary to employ in order to avoid error.

[6] *Archiv für Anthropologie*, Bd. xiii. p. 53, 1882.

In this way uniform results can undoubtedly be arrived at, but as is now admitted the cubage so obtained gives a higher numerical value to the contents than is the actual capacity of the cranium as tested by the employment of water for the purposes of cubage. This is not to be wondered at when it is remembered that the shot is rammed into the cranial cavity to its utmost capacity, whilst no corresponding pressure is applied to the shot after pouring it into the cubic measure, so that necessarily it occupies a greater space in the measure than in the skull. Dr. E. Schmidt, whilst recognising that Broca's method is not only the most practicable, but also the most precise of all the methods up to that time employed, has yet found it necessary to draw up tables by means of which the measurements taken according to Broca may be reduced to the actual capacity. Thus when shot is employed, whilst Broca's method would give 1000 cubic centimetres, the actual capacity is 931, making a difference of 69, and the difference gradually rises until a capacity of 1500 (Broca) is only 1409 (Schmidt), and one of 2000 (Broca) is 1887 (Schmidt), the difference between the apparent and real capacities in the last example being as much as 113 cc.

What is undoubtedly a desideratum in the determination of the cranial capacity is a method which will bring the two processes of guaging the skull and cubing its contents into precisely uniform conditions, so that the number obtained in the cubage may express the actual capacity. I have performed a number of experiments with this object, and have now elaborated a method which gives results so nearly uniform when tested with a standard skull, that it may, I think, be taken as furnishing in each case a close approximation to the actual capacity. This standard skull was itself prepared by stopping all the foramina, except the foramen magnum, with cement and by coating both the inner and outer tables with sealing wax varnish. The method is based upon two of the most important principles insisted on by Broca, viz., that the size of the particles employed must be uniform, and that they should be poured into the skull through a funnel, the neck of which has a definite diameter.

No. 8 chilled shot has been employed as, from its hardness, it preserves its globular form much more efficiently than ordinary shot.[1] A litre is filled with this shot, which is then poured into the foramen magnum through a funnel 14·5 centimetres wide at the mouth, and 12·5 cm. in depth, the spout of which is 2 cm. long and 2 cm. wide. The skull is then lifted in both hands and a sharp tilt forwards given to it so as to project the shot into the anterior and middle cranial fossæ. Shot is again poured in through the same funnel until it reaches the foramen magnum, care being taken that it shall pass well down into the occipital region. The skull is again lifted and a sharp tilt given, first

[1] I attach importance to the preservation of the globular form of the shot, as it thereby runs much more uniformly than if the particles were flattened or irregularly shaped. An objection to the method of ramming the shot employed by Broca is the constant change of form which the particles are made to undergo, and the alteration therefore in the number of their surfaces of contact.

to the right and then to the left. More shot is then poured through the funnel until it reaches the foramen, when the thumb is placed on the shot and pressed into the cavity downwards and backwards; the measure of resistance offered to the thumb expresses whether in the previous operation the cranial cavity has been properly filled. Shot is again poured through the funnel until the skull is filled to the foramen magnum. It will be observed that I do not ram the shot in the process of guaging, and do not therefore overfill the cavity.

In cubing the contents the shot is not poured into a litre and a demi-litre measure, as was the practice of M. Broca, but through the same funnel as that used in filling the skull into the large 2 litre glass cylinder graduated in intervals of ten centimetres, devised by Prof. Ranke of Munich, and for a gift of which I am greatly indebted to that eminent anthropologist.[1] Each skull was gauged and cubed at least twice, once by myself, and once by my museum assistant Mr. James Simpson. The figures stated in the tables are the mean of the two measurements, and in no case was a measurement accepted where a difference occurred of more than 10 cubic centimetres. When such a difference arose, as occasionally took place from inadvertence in not attending to some of the necessary precautions, the skull was at once remeasured. I have arranged the skulls according to their capacities into three divisions, and have employed the same numerical classification as Prof. Flower; viz.: Microcephalic below 1350; Mesocephalic between 1350 and 1450; Megacephalic above 1450 cubic centimetres.

BUSH RACE, SOUTH AFRICA.

Plates I., VI. Tables I., XVIII., XIX.

Two crania, both apparently males, were collected by the Challenger Expedition. In the same box were the pelvic bones and long bones of the limbs of one skeleton, but these were unfortunately so much injured that exact measurements could not be taken. No memorandum of the donor of these skulls has been preserved, but Mr. Murray thinks that they were presented by the late Dr. Bleek. Along with them were several stone implements shaped into lance heads, a large perforated stone ball, some fragments of pottery and two Ostrich eggs. I have examined along with these specimens five other Bush crania,[2] one of which was a child of about nine years, and the remarks which follow

[1] Prof. Ranke has since devised a reproduction of a skull in bronze, in which all the inequalities of the cranial cavity are reproduced, and which, from the imperviousness of its walls, both to water and mercury, enables either of these agents to be employed so as to obtain a definite standard of comparison. Prof. Ranke brought this bronze skull under the notice of the Deutsche Gesellschaft für Anthropologie, October 1882. See the Correspondenz Blatt, p. 137, in *Archiv für Anthropologie*, Bd. xv., 1884.

[2] One specimen was purchased for the University Anatomical Museum many years ago; a second, being the one figured in Plate I., was presented along with the skeleton by Dr. P. C. Sutherland and W. Proudfoot, Esq., of Natal. This man came from the mountains at the source of the Umzimkulu and St. John's river. He had been about twelve years

are based on the investigation of seven skulls. The six adult crania were with one exception probably all males.

Norma verticalis.—Crania elongated antero-posteriorly. Parietal eminences usually well marked, and placed near the back of the side of the skull. Frontal eminences distinct. Skull somewhat flattened on summit. No median ridge in sagittal region. Cryptozygous except in two specimens, in which the zygomatic arches were just visible. The stephanic diameter was in three specimens less than, in two equal to, and in two greater than, the asterionic.

Norma lateralis.—All the skulls rested behind on the cerebellar part of the occipital bone. In only one was there much projection of either the glabella or supraciliary ridges. In all the frontal bone ascended almost vertically from the glabella, and the frontal region of that bone passed somewhat abruptly into the coronal region. In three specimens a median ridge marked the position of the obliterated frontal suture. The tendency to flattening of the vault gave a low curve to the vertex. There was no marked flattening in the region of the obelion and upper occipital squama, such as would have been produced by artificial pressure. The squama projected behind the occipital protuberance. The frontal longitudinal arc was in each skull markedly greater than the occipital; in four specimens it was greater than the parietal; whilst the parietal was in five skulls greater than the occipital.

The nasal bones were not strongly developed; they never exceeded 25 mm. in length, and 7 mm. in breadth; not unfrequently they were partially fused together. The bridge of the nose was so flattened that the nasals formed almost a plane surface between the nasal processes of the superior maxillaries, and there was, with one exception, scarcely any depression at the naso-frontal suture. The nasal spine of the superior maxillæ was feeble. The junction of the side walls with the floor of the anterior nares was rounded. In five of the crania there was a marked depression in the frontal, immediately above the external angular process, which gave great prominence to that process. In five crania the infra-orbital and canine fossæ were deep, in two shallow. The infra-orbital part of the malar bones projected forwards and approximated to the plane of the lower border of the nasals, so that the face in the fronto-naso-orbital region was flattened. The interzygomatic breadth invariably exceeded the intermalar, stephanic or asterionic, but was considerably less than the interparietal breadth. The intermalar was in three cases greater than the stephanic, once equal to and twice somewhat less than it. The face

with Mr. Proudfoot, and died of phthisis. Two were presented by one of my pupils, Mr. W. J. van der Merwe. They were from his father's estate of Drift, Calvinia district. One was a male somewhat advanced in years, the other a child about nine. The adult skull which I believe to be female was lent to me in November 1883, by Adam Sedgwick, Esq., of Trinity College, Cambridge, to whom it was given by Dr. Theophilus Hahn, the Colonial Philologist. It came from Uitenhag in the eastern district. Although I did not receive this skull until after the bulk of the Report was in type, I have been able to include it in the table of measurements, and to incorporate its characters in the text.

was broad and flattened in the norma facialis. The mean interorbital breadth was 23·5 mm.; the maximum 27 mm.; the minimum 21 mm.

The teeth were fully erupted in five crania, and in the adult from Drift, Calvinia, the sockets of the lower molars and upper incisors and canines were absorbed. In one skull the upper wisdoms were only partially erupted, and in the child's skull the dentition marked the 8th or 9th year. Except in the child and one of the adults the teeth were much worn, even in the skull with imperfectly cut wisdoms, but there was no decay.

The cranial sutures in B were simple in their denticulations, the sagittal immediately in front of the obelion was deflected to the right, and small Wormian bones were in the lambdoidal suture. In the other skulls the sutures were more deeply denticulated, and small Wormian bones were not unfrequent in the lambdoidal suture. In three the sutures were in course of senile obliteration. No skull was metopic, and the temporal squama did not articulate with the frontal. The temporal ridges were not strong.

In two crania the ossa plana of the ethmoid were small. In one of these on both sides, and in the other on the right side only, the orbital plate of the superior maxillary sent a process between the os planum and the lachrymal to articulate with the frontal (Pl. I. fig. 4); when a fronto-maxillary articulation occurs in the inner wall of the orbit, it marks a reversion to the pithecoid arrangement, and is a sign of degradation of the human cranium; for in the Gorilla and other species of *Troglodytes* the os planum is triangular, and the frontal and superior maxilla articulate with each other between it and the lachrymal on the inner wall of the orbit. In two, faint indications of a maxillo-premaxillary suture were seen on the hard palate. The malar was not in any specimen divided either wholly or partially by a suture, and did not therefore conform to a character which Rolleston thought to be not unfrequent in Bush crania. One skull had a long right paramastoid which possessed a broad smooth articular surface at its lower free end for the transverse process of the atlas.

The lower jaw was present in six crania. In all the chin was feeble and with but a slight forward projection; the coronoid process was short, the sigmoid notch shallow, and the incisors almost vertical. The antero-posterior diameter of the ascending ramus, on a line with the alveolar border, was, as a rule, from 30 to 31 mm. In four adults the angle was everted at the insertion of the masseterics, very markedly so in two specimens, and there was only a slight hollowing on the inner surface of the ramus. In all the gonio-symphysial and intergonial diameters were either equal or almost equal.

In the six adult crania the mean cephalic index was 75·9, and the range of variation from the minimum 75 to the maximum 76·5 was only 1·5; the skulls were therefore mesaticephalic. The mean vertical index was 71, and the range from 69 to 73 was 4. The mean height was therefore distinctly below the mean breadth, and in no specimen did the height equal the greatest breadth; the skulls were tapeinocephalic. The mean gnathic index was 96·7, and the range from the minimum 92·6 to the maximum 102 was

9·4 ; the average was orthognathic, only one adult being mesognathic. The mean facial index was 65, and the range from 62 to 69 was 7. The mean nasal index was 54·85, and the range from 48 to 62·5 was 14·5 ; the mean was platyrhine, but the individual crania ranged from the lowest term of the mesorhine to the platyrhine. The mean orbital

TABLE I.—BUSH RACE, SOUTH AFRICA.[1]

	Collection,	Uitenhag.	Chal. A.	Chal. B.	E.U.A.M.	Umzimkulu. E.U.A.M.	Drift. E.U.A.M.	Drift. E.U.A.M.
	Age,	Aged.	Ad.	Ad.	Ad.	Ad.	Aged.	8 or 9
	Sex,	F.	M.	M.	M.	M.*	M.	F.?
	Cubic capacity,	1092	1135	1365	1420	1240	1435	...
	Glabello-occipital length,	170	177	177	186	182	182	174
	Ophryo-occipital ,,	170	176	175	183	180	182	174
	Basi-bregmatic height,	123	130	129	130	130	126	119
	Vertical Index,	*72*	*73*	*73*	*70*	*71*	*69*	*68*
	Minimum frontal diameter,	95	88	96	96	92	95	...
	Stephanic ,,	107	98	112	116	98	118	100
	Asterionic ,,	107	102	107	116	104	105	106
	Greatest breadth,	130*p*	132*s*	134*s*	141*s*	138*p*	139*p*	134*s*
	Cephalic Index,	*76·5*	*75*	*76*	*76*	*76*	*76*	*77*
	Horizontal circumference,	482	493	498	520	503	523	485
	Frontal longitudinal arc,	120	135	131	125	130	133	121
	Parietal ,, ,,	125	115	105	148	124	132	123
	Occipital ,, ,,	104	118	126	110	112	105	106
	Total ,, ,,	349	368	362	383	366	370	350
	Vertical transverse arc,	272	294	293	300	288	300	286
	Length of foramen magnum,	35	33	39	36	32	36	37
	Basi-nasal length,	90	93	95	98	104	100	88
	Basi-alveolar length,	88	89	88	100	99	...	90
	Gnathic Index,	*97·7*	*96*	*93*	*102*	*95*	...	*102*
	Interzygomatic breadth,	119	118	119	...	125	126	114
	Intermalar ,,	110	108	110	...	116	114	100
	Ophryo-alveolar length,	75	77	82	81	78	...	69
	Naso-alveolar ,,	57	59	64	60	58	...	53
	Facial Index,	*63*	*65*	*69*	...	*62*	...	*60·5*
	Nasal height,	42	43	48	45	48	44	37
	Nasal width,	25	21	23	24	30	22	23
	Nasal Index,	*59·5*	*49*	*48*	*53*	*62·5*	*50*	*62*
	Orbital width,	36	38	37	37	38	36	32
	Orbital height,	30	31	31	28	29	32	30
	Orbital Index,	*83*	*82*	*84*	*76*	*76*	*89*	*94*
	Palato-maxillary length,	...	...	48	58	53	...	48
	Palato-maxillary breadth,	...	58	56	65	68	61	58
	Palato-maxillary Index,	...	...	*117*	*112*	*128*	..	*121*
Lower Jaw.	Symphysial height,	27	31	31	...	28	31	26
	Coronoid ,,	42	58	50	...	54	51	49
	Condyloid ,,	41	49	45	...	47	45	41
	Gonio-symphysial length,	83	86	85	...	89	90	79
	Inter-gonial width,	83	85	89	...	89	89	79
	Breadth of ascending ramus,	35	31	31	...	31	31	30·5

[1] In this and the succeeding tables Chal. signifies the Challenger Collection ; E. U. A. M., the Anatomical Museum of the University of Edinburgh.

* With pelvis.

index was 81, and the range from 76 to 89 was 13; the orbits were microseme, with the exception of one which was mesoseme. The mean palato-maxillary index was 119, and the range from 112 to 128 was 16; the palato-alveolar region was therefore brachyuranic. The mean cubic capacity of the five adult male crania was 1319 c.c., the maximum 1435, the minimum 1135, the range being 300 cubic centimetres; the internal capacity of the adult female was only 1092 c.c.; in their average capacity the skulls were microcephalic, but three specimens were mesocephalic.

The skulls were therefore in their average proportions mesaticephalic, tapeinocephalic, cryptozygous, orthognathic, platyrhine, mesoseme brachyuranic and microcephalic.

Crania said to belong to the Bush race have been described, and in several instances figured, by Blumenbach,[1] Sandifort,[2] W. C. L. Martin,[3] Owen,[4] Williamson,[5] Van der Hoeven,[6] Vrolik,[7] Barnard Davis,[8] Fritsch,[9] Zuckerkandl,[10] Flower,[11] de Quatrefages with Hamy,[12] and Rolleston.[13] The precise localities in south Africa in which the Bush people lived, to whom the majority of these skulls belonged, have unfortunately not been stated; but the districts from which others, as well as some of those now described by myself, were obtained, are recorded. They have been procured from a wide geographical area, extending from Clanwilliam and Calvinia on the west, to the sources of the Umzimkulu and St. John's rivers on the east, and ranging northwards and eastwards through the Transvaal to the country between the Tati and Ramaquehan rivers in Matabele Land. The last-named locality, in lat. 20° 54′ long. 27° 42′, is the most northerly spot from which Bush skulls have as yet been obtained. These specimens were collected by the late Mr. Frank Oates,[14] and were described by the late Dr. Rolleston. But the range of these people is even greater than is implied in the above statement, as they probably form scattered hordes in the middle of the continent extending northwards to the 19th or 20th degree of latitude, and also reach the west coast in the district

[1] Decas quinta collectionis suæ Craniorum, p. 12, pl. xlv.

[2] Tabulæ Craniorum.

[3] Natural History of Man and Monkeys, p. 298, 1841.

[4] Catalogue of Osteological Series in Museum of Royal College of Surgeons, vol. ii. p. 832, 1853. Anatomy of Vertebrates, vol. ii. p. 564, 1866.

[5] Observations on Human Crania in Army Medical Museum, Chatham, *Dublin Quarterly Journal of Medical Science*, May and August, 1857, and as a separate reprint.

[6] Catalogus Craniorum diversarum gentium, Leyden, p. 58, 1860.

[7] Musée Vrolik, p. 55.

[8] Thesaurus Craniorum, p. 216, 1867.

[9] Die Eingeborenen Süd-Afrika's, p. 410, 1872. Also, Die afrikanischen Buschmänner als Urrasse, in *Zeitschr. für Ethnologie*, Bd. xii. p. 289, 1880.

[10] Reise der Novara, Anthropologischer Theil, pp. 55, 64, 1875.

[11] Catalogue of Osteological Specimens, pt. i., p. 246, 1879.

[12] Crania Ethnica, p. 389, 1882.

[13] Appendix to Matabele Land, by Mr. Frank Oates, p. 273, 1881, and reprinted in Rolleston's collected Scientific Papers and Addresses, edited by Prof. Turner, p. 462, Oxford, 1884.

[14] Matabele Land and the Victoria Falls, p. 231, London, 1881.

of Great Namaqua Land.[1] It is probable that before, and in the early days of, the European colonisation, tribes of Bushmen lived as far south as the Cape itself, so that one may agree with the following statement made by Dr. Fritsch[2] that throughout South Africa, from the Cape up to the Zambesi, and probably still further north, the territory of the Bush people had extended.

The skulls ascribed to the Bush race, including those described in this Report, which have now been examined by craniologists, are at least forty-six in number, and of these about two-thirds are apparently male skulls. A sufficient number has therefore been studied to enable one with some degree of certainty to state the characters of the Bush skull.

From a comparison of the several descriptions it is evident that in these crania the forehead approaches the vertical; the frontal and parietal eminences are as a rule prominent; the skull is flattened on the vertex; the glabella and supraciliary ridges are not strongly marked, although Fritsch regards them as more prominent than in the skull of the Hottentot; the nasal region is flattened, and the nasal bones enter into the profile outline of the face only by their lower ends, so that the Bush profile markedly contrasts with that of such skulls as the Fuegian drawn on Pl. I.; the malar bones project forwards; the nasal spine of the superior maxillæ is feeble; the skull generally is small.

The length and breadth of thirty-six crania have been recorded by Van der Hoeven, Vrolik, Barnard Davis, Fritsch, Zuckerkandl, Flower, de Quatrefages with Hamy, Rolleston, and myself. If we exclude one described by Zuckerkandl (No. 67), the cephalic index of which was 66·6, and another by Barnard Davis with a cephalic index 67 (No. 388, Thesaurus Craniorum), both of which from their extreme narrowness were probably either deformed skulls or not crania of the Bush race, the mean length-breadth index of the remaining thirty-five crania was 75·2, which places the skulls in the mesaticephalic division. Of these specimens twenty-three had a cephalic index of 75 or upwards, and the highest of these, a specimen described by Rolleston, being one of the males collected by Mr. Frank Oates, had an index of 81. The remaining twelve fell below 75, and the lowest of these were specimens described by Fritsch and Vrolik which had the cephalic indices respectively of 69·4 and 69·9.

On comparing my series of crania with the published figures of other specimens, there is obviously a difference in the amount of backward projection in the occipital region. This is especially to be noted in the skull originally described by Blumenbach, a profile view of which has recently been given by MM. de Quatrefages with Hamy (p. 391,

[1] Stieler's Hand-Atlas, Nos. 71, 72, Gotha, 1882.

[2] Die Eingeborenen, &c., p. 386. Fritsch gives the mean height of six Bushmen as 144·4 cm., and of five women as 144·8 cm., so that the women were 0·4 cm. taller than the men. This is similar to the experience of Dr. Louis Vincent who states (*Revue d'Anthropologie*, t. i. p. 453, 1872) that it is seldom that a Bush person exceeds 1·40 m. in height; that the mean height is 1·30 m., and that the women are a little taller than the men.

fig. 347). This skull has a cephalic index of 73·03, and is therefore distinctly dolichocephalic, its more elongated index being apparently due to its occipital projection. Dr. Williamson also, who does not, however, give any measurements, states that the occiput is well rounded and frequently prominent in Bush crania.

The height of thirty-two crania has been given by Barnard Davis, Fritsch, Flower, de Quatrefages with Hamy, Rolleston, and myself, and the mean vertical index of these specimens is 71, which precisely corresponds with the mean of my six adult crania. Seventeen of these crania had a vertical index of either 71 or less, and in one skull described by Prof. Rolleston the index was as low as 65; in another, from Mr. Oates's collection, described by the same anatomist, it reached as high as 78, but this was quite exceptional. The Bush crania, therefore, are decidedly tapeinocephalic. It is obviously a general character of the Bush skull that the vertical diameter is less than the greatest breadth.

In fifteen crania a gnathic index has been calculated by Flower, Rolleston, and myself, from a comparison of the basi-nasal with the basi-alveolar diameters. The mean index in these specimens was 97·9, which places the skulls in the orthognathic series. Several of the specimens were, however, above 98, which is taken as the upper limit of orthognathism, and three reached 102; so that individual skulls have a forward projection of the upper jaw considerably above the average of the race, but in no instance did they attain that degree of prognathism which is characteristic of the negro. The want of projection of the upper jaw in these people is also testified to by Dr. Williamson, who in his excellent description of the Bush crania in the Army Medical Museum states that "the alveolar processes are straight and broad in front, and do not project, but the position of the sockets causes the teeth to stand forwards."

The nasal index has been computed in twenty-one specimens by Flower, de Quatrefages with Hamy, Rolleston, and myself, and the mean index is 58·4, which places these skulls well into the platyrhine series. The mean of this large series of crania is, however, less than that obtained by either Flower, de Quatrefages with Hamy, or Rolleston, in their respective series, owing to the low mesorhine indices (48, 49, 50) in three of the specimens which I have recorded, and yet these mesorhine crania had in other respects well-marked Bush characters. The width of the nasal aperture is also specially referred to by both Williamson and Fritsch as a feature in the Bush skull.

The orbital index has been calculated in the same twenty-one specimens, and the average is 83, which places the skulls in the microseme series. A considerable range, however, prevailed in this index, for in a skull described by Dr. Rolleston it was as high as 100, and in another skull measured by the same anatomist it fell to 73.

The palato-maxillary index has as yet only been recorded in the skulls described in this Report; the mean of the measurements of four crania being 119·5, which places these skulls in the brachyuranic series.

The mean internal capacity of Prof. Flower's specimens was 1252, that of Dr. Rolleston's 1285, of my own 1281. All therefore are microcephalic.

As a result of the examination of the collective measurements of the extensive series of Bush crania which have now been recorded by craniologists, one may state that these skulls are on the average mesaticephalic, tapeinocephalic, orthognathic, platyrhine, microseme and microcephalic. This result corresponds therefore with that at which Flower, Rolleston, and myself had independently arrived from the examination by each of us respectively of the series of crania which had passed through our hands.

Dr. Rolleston has also directed attention to the form of the lower jaw as very characteristic of the Bush cranium. My specimens closely corresponded in the feebleness of the chin, the lowness of the coronoid process, the shallow sigmoid notch, and the everted angle with his description, but the hollowing out below the internal dental foramen to which he also refers was not specially noticeable. Further, I may point out another character which obviously deserves consideration, viz., the almost equality in length between the diameter from the angle of the jaw to the chin, and that between the opposite angles of the same bone. In each skull the basi-nasal and the basi-alveolar diameters exceeded the gonio-symphysial length, and similarly the intergonial diameter was always below the minimum frontal diameter in the same cranium.

Dr. Fritsch also lays considerable stress upon the breadth of the face, on that of the skull in the spheno-frontal region, and indeed on the breadth of the transverse measurements generally, in the Bush crania. In my description (p. 11) I have pointed out how the transverse diameter in the parietal region greatly dominated over the interzygomatic, so that the skulls were cryptozygous.

FUEGIAN AND PATAGONIAN.

Plates I., VI. Tables II., XVIII., XIX.

The crania marked Fuegian consisted of four adult specimens, only one of which possessed a lower jaw. This specimen was soldered up in a zinc case marked "Head of a Fuegian," but all the flesh had been removed and the brain was putrid; it is the skull D in the following description. One skull was marked Patagonian. All these crania were obtained at Puntas Arenas, in Magellan's Strait, and were presented as undoubted Fuegian skulls to Sir Wyville Thomson by Don Diego Dublé Almeida, the Governor of the Chilian colony. Two of the Fuegian crania were somewhat injured, but the other two and the skull marked Patagonian were in good condition.

Fuegian.—The Fuegian skulls are distinguished in the following description by the letters A to D inclusive. A and D were males, C was a female. B was more difficult to determine, but probably a female.

Norma verticalis.—These crania had no marked antero-posterior elongation. The line of the sagittal suture was elevated into only a slight ridge, except in A, in which, however, the region of the anterior fontanelle was flattened. Between the sagittal suture and the parietal eminences and temporal ridge the vault was somewhat flattened, and sloped downwards and outwards, so as to give what Prof. Cleland names an "ill-filled" character to this region of the skull. The eminences themselves were distinct, though not particularly prominent, and below them each skull bulged out slightly, so that the greatest breadth was in the squamous region. A and B were distinctly phænozygous, D slightly so, C not at all. In three of these skulls the asterionic diameter was slightly more than the stephanic in the same specimen. In the fourth the stephanic was 7 mm. more than the asterionic diameter.

Norma lateralis.—The skulls rested in front on the crowns of the upper molars, and behind on the cerebellar region of the occiput. In A and D the glabella and supraciliary ridges were distinct, but in B and C comparatively feeble. The profile outline formed a continuous curve from the glabella to about the obelion, but from that region the skull sloped downwards and backwards to the occipital point, and was somewhat flattened. In B this slope was more nearly vertical, but in none of the crania was there evidence of artificial parieto-occipital flattening. The occipital squama projected behind the protuberance, but in A a well-marked mesial depression existed between the protuberance and the superior angle. The frontal longitudinal arc in one case exceeded the parietal, the parietal and frontal arcs in one skull each exceeded the occipital, but in the others the occipital arc was the longest. The basi-nasal diameter in each specimen was longer than the basi-alveolar.

The nasal bones were elongated, and ranged from 26 to 31 mm.; their width varied from 11 to 15 mm. They projected downwards and forwards, and the bridge of the nose was prominent and concavo-convex from root to tip, and formed a marked feature in the facial aspect of these crania. The nasal spine of the superior maxillæ was strong in both A and D. The junction of the side walls with the floor of the anterior nares was not much rounded. In three of the crania there was a marked depression of the frontal bone, immediately above the external orbital process, which gave prominence to that part of the orbital border. This depression extended upwards and backwards in front of the temporal ridge, and, owing to the feebly developed frontal eminences, contributed to impart a slope to the forehead from the external orbital process and temporal ridge upwards and inwards towards the mesial line of the frontal. The temporal ridge in two of the crania was strong and in all divided into an upper and a lower part.

In each skull the interzygomatic diameter was much greater than either the stephanic or asterionic, and in every skull but C the intermalar diameter also exceeded the stephanic and asterionic. In two cases the interzygomatic diameter was slightly more than the greatest breadth in the parieto-squamous region, and in the other two it was decidedly

less. The inter-orbital width was either 21 or 22 mm. In D, the only one which had a lower jaw, the length of the face from the ophryon to the chin was 140 mm., and from the fronto-nasal suture to the chin 118 mm.

The teeth in all were fully erupted, though many of the sockets were empty. In A and B the crowns were much worn and flattened, but there was no decay.

The cranial sutures, except in C, were simple in their denticulations. In A and B they

TABLE II.—FUEGIAN AND PATAGONIAN.

		Fuegian. Chal.				Patagonian.
		A.	D.	B.	C.	Chal.
	Collection,	Ad.	Ad.	Ad.	Ad.	Ad.
	Age,	M.	M.	F?	F.	M.
	Sex,	1390	1362	1190	1392	1290
	Cubic capacity,	182	186	175	182	182
	Glabello-occipital length,	179	183	175	182	181
	Ophryo-occipital „	137	138	133	132	141
	Basi-bregmatic height,	*75*	*74*	*76*	*72·5*	*77*
	Vertical Index,	102	95	97	96	99
	Minimum frontal diameter,	112	108	108	114	112
	Stephanic „	113	114	110	107	110
	Asterionic „	141*s*	136*s*	137*s*	142*s*	141*s*
	Greatest breadth,	*77·5*	*73*	*78*	*78*	*77·5*
	Cephalic Index,	520	520	493	515	521
	Horizontal circumference,	122	125	110	130	124
	Frontal longitudinal arc,	123	115	119	...	110
	Parietal „ „	120	133	122	...	140
	Occipital „ „	365	373	351	372	374
	Total „ „	302	300	282	308	297
	Vertical transverse arc,	38	36	32	35	35
	Length of foramen magnum,	106	106	102	100	101
	Basi-nasal length,	104	102	97	...	101
	Basi-alveolar length,	*98*	*96*	*95*	...	*100*
	Gnathic Index,	143	130	139	130	144
	Interzygomatic breadth,	127	117	123	112	125
	Intermalar „	90	100	93	...	101
	Ophryo-alveolar length,	66	70	70	...	75
	Naso-alveolar „	*63*	*77*	*67*	...	*70*
	Facial Index,	52	54	51	...	53
	Nasal height,	22	22	25	21	26
	Nasal width,	*42*	*41*	*49*	...	*49*
	Nasal Index,	39	39	38	38	39
	Orbital width,	34	36	36	37	38
	Orbital height,	*87*	*92*	*95*	*97*	*97*
	Orbital Index,	58	54	54	...	55
	Palato-maxillary length,	63	60	62	62	66
	Palato-maxillary breadth,	*109*	*111*	*115*	...	*120*
	Palato-maxillary Index,					
Lower Jaw.	Symphysial height,	...	31	...	...	...
	Coronoid „	...	73	...	...	...
	Condyloid „	...	68	...	...	...
	Gonio-symphysial length,	...	99	...	...	...
	Inter-gonial width,	...	94	...	...	...
	Breadth of ascending ramus,	...	41	...	...	...

were in course of being ossified, and these skulls were of more advanced age. In C a well-marked triquetral bone formed the superior angle of the occipital squama, and a large Wormian bone was in the right pterion. In none did the temporal squama articulate with the frontal, or was the frontal suture persistent. In all the os planum of the ethmoid had a quadrilateral form. In none was the maxillo-premaxillary suture visible on the palatal surface. In all the hard palate was hollowed into a deep fossa where the posterior palatine foramen opened, and in three of the crania this fossa had a depth of 15 mm. opposite the second molar. The exoccipitals were tumid on the inferior surface, and in B slightly, but in D more definitely, projected downwards, so as to form a short paramastoid process.

The lower jaw of D was a well-developed bone, with a good chin. The angle was almost rectangular but not everted, and the teeth were all present. The gonio-symphysial length was somewhat greater than the intergonial width.

The mean cephalic index of the four crania was 76·6 : the maximum (female) was 78, the minimum (male) 73. The crania were therefore mesaticephalic, three being above its lowest term, but D was dolichocephalic. When D was omitted the mean cephalic index of the rest was 77·8. The mean vertical index was 74·4 : the maximum 76, the minimum 72·5, both females. The height was somewhat below the mean breadth ; only in D, a male, did the height exceed the breadth, and in the undoubted female skull the smaller relative height was well marked. In three cases the vertical index was less than the cephalic. The skulls were metriocephalic. The mean gnathic index was 96 : the maximum (male) 98, the minimum (female) 95. The face was therefore orthognathic. The mean facial index was 69 : the maximum (male) 77, the minimum (female) 63. The mean nasal index was 44 : the maximum (female) 49, the minimum (male) 41. The nose was therefore leptorhine, only one specimen slightly exceeding its highest term. The mean orbital index was 93 : the maximum (female) 97, the minimum (male) 87. All the skulls were megaseme, except one male, which was mesoseme. The mean palato-maxillary index was 111·5 : the maximum (female) 115, the minimum (male) 109 ; there was no great disproportion between the length and breadth of the palato-alveolar region ; the index of which was mesuranic. The mean capacity of the four crania was 1333·5 cubic centimètres ; that of the two presumable males was 1376 ; that of the two presumable females 1291 c.c. The two males were mesocephalic, whilst the average of the females, as well as that of the series of four skulls, was microcephalic.

These Fuegian crania were therefore on the average mesaticephalic, metriocephalic, tending to phænozygous, orthognathic, leptorhine, megaseme, mesuranic and microcephalic.

Patagonian.—The single skull marked Patagonian was an adult male. It corresponded in general form with the Fuegian A. It had the same cephalic index 77·5, and was therefore mesaticephalic. Its vertical index, greater than in A, and almost as high as its

cephalic index, was just akrocephalic. The stephanic diameter slightly exceeded the asterionic, but both were below either the interzygomatic or intermalar. The interzygomatic was slightly more than the greatest transverse diameter in the parieto-squamous region. The interorbital width was 24 mm. The frontal longitudinal arc was greater than the parietal, and both were considerably below the occipital. The basi-nasal and basi-alveolar length were equal, and the index was mesognathic. The skull was phænozygous. It was depressed in the frontal region above the external orbital process. The palatal fossa was 17 mm. deep opposite the second molar. The nasals were 30 mm. long, and the bridge of the nose was prominent and concavo-convex. The pterion was normal, and there were no Wormian bones. The skull rested behind on the cerebellar region of the occiput. In its capacity of 1290 c.c. it was microcephalic. In its facial characters and proportions it differed from A in the following:—the gnathic, facial, nasal, orbital, and palato-maxillary indices were all greater, but the facial, nasal, and orbital indices did not exceed the corresponding indices of others of the skulls marked Fuegian. It showed no sign of artificial deformity.

Very few Fuegian skulls have been examined by craniologists. The specimens contained in museums, and up to this time recorded, do not apparently exceed nine in number, and of these six are apparently males and three females. The authorities who have written on these crania are Professors Owen,[1] Huxley,[2] Flower,[3] and de Quatrefages with Hamy.[4] To this list are now to be added the four skulls described in this Report.

Prof. Owen's description is limited to a single male skull, which, together with a considerable part of the skeleton, is in the Museum of the Royal College of Surgeons of England (No. 5428, Old Cat.). The same skull is figured by Prof. Huxley, and a brief reference is also made by him to another cranium, probably that of a young woman, collected by Dr. R. O. Cunningham at Philip Bay. Prof. Flower gives the principal measurements (No. 1025, New Cat.) of the skull already described by Owen and figured by Huxley, as well as of two other crania from Fuegia (Nos. 1026, 1027), and since the catalogue was published two additional specimens have been presented to the College of Surgeons, the one, a male, found in a shell heap near Ooshooia, the measurements of which are recorded in manuscript in the museum copy of the catalogue (No. 1025, *a*),[5] the other of a young girl about 15 (No. 1027, *a*). MM. de Quatrefages and Hamy have recorded the measurements of two crania, one of which, from Desolation Land, they have figured in pl. lxxv. figs. 3 and 4.

The measurements and figures of such of the skulls as have been published show that

[1] Catalogue of Ost. Series in Mus. Roy. Col. Surgeons, vol. ii. p. 846, 1853.

[2] *Journal of Anatomy and Physiology*, vol. ii. p. 253, 1868.

[3] Cat. of Ost. Specimens, pt. 1, p. 179, 1879.

[4] Crania Ethnica, p. 478.

[5] Prof. Flower gives the cephalic index as 73·4, the vertical index as 71·9, the gnathic as 100·9, nasal 49·1, and orbital index 95·1. The skeleton was said to be that of a remarkably tall man.

they varied considerably in the relation of the length and breadth of the cranium. The two measured by MM. de Quatrefages and Hamy had a mean cephalic index 74·8, whilst those measured by Prof. Flower ranged from 73·4 to 81·8. Similarly the four skulls described by me in this Report varied considerably, the lowest D being 73, whilst the others were either 77·5 or 78. The skull which Prof. Huxley figured had a cephalic index 74, so that he draws the conclusion that the Fuegian skull is dolichocephalic, and with this conclusion MM. de Quatrefages and Hamy concur. But if we take the whole series of eleven skulls, including those published in this Report, the cephalic indices of which have been recorded, we shall find that only six were below 75 (the lowest being 73), whilst the mean of the series was 76·5. Hence, if 75 be regarded as marking the highest term of dolichocephalism, the average index places them in the mesaticephalic group, though somewhat more than one-half were dolichocephalic. Notwithstanding the high mesaticephalic index of three of the skulls which I have described, the parieto-occipital region in them had much more the shape to be seen in skulls of dolichocephalic than of brachycephalic proportions, and the parietal eminences were not set so far back on the side of the cranium as one sees in brachycephalic skulls. The specimen D which I have figured (Pl. I. figs. 5, 6) closely corresponded in its contour with the skull figured by Prof. Huxley and with that delineated by MM. de Quatrefages and Hamy.

To afford a convenient opportunity of making a comparison, I reproduce, from the Journal of Anatomy and Physiology, the four views of the Fuegian skull figured by Prof. Huxley.[1]

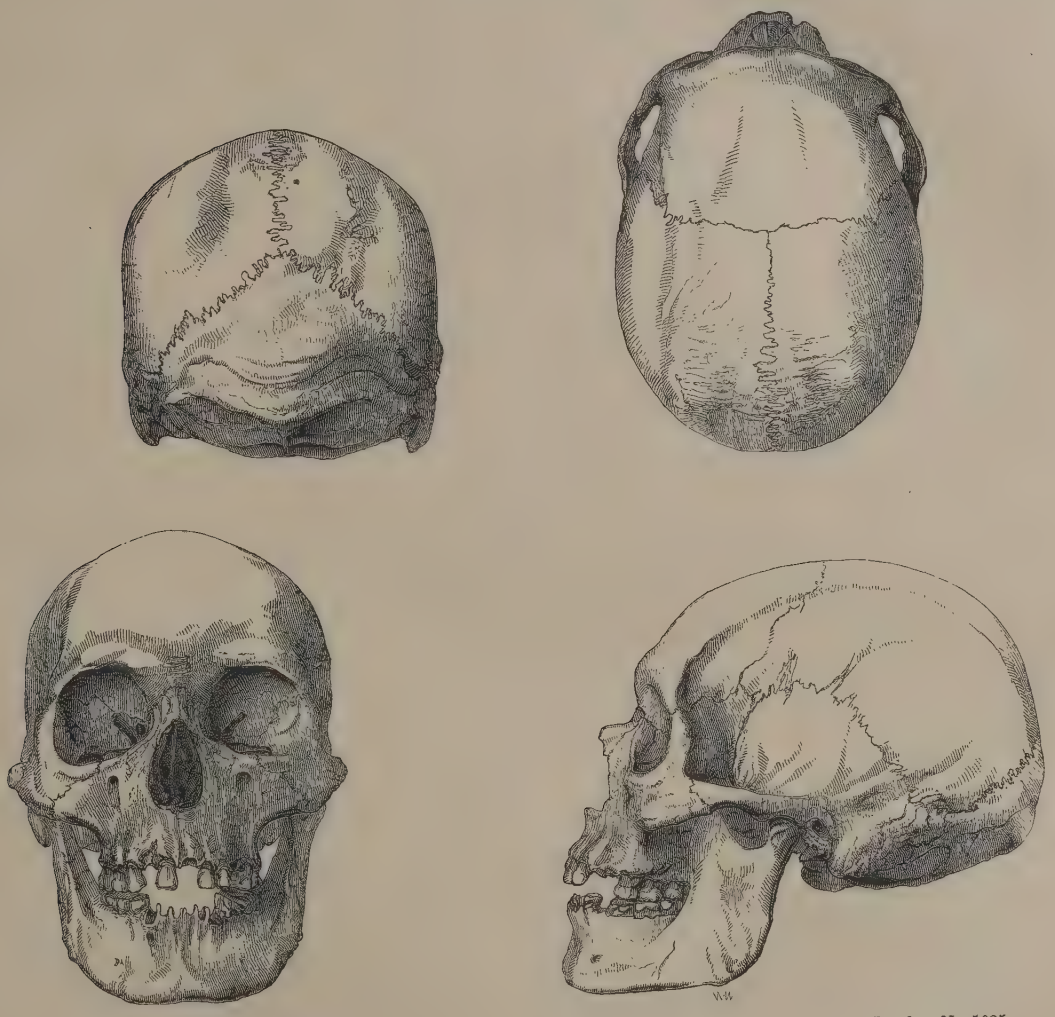
There can, I think, be no question that D is an authentic specimen of a Fuegian skull, not only from its resemblance to those above referred to, but because, from the attempt, unfortunately unsuccessful, to preserve the brain, the man must have died at Sandy Point, and was doubtless known to have been a Fuegian. My other specimens, although differing in their cephalic indices so much from the skull D, yet agree with it in many other of its characters, and are probably also the skulls of Fuegians who had died at Sandy Point, to which settlement some of the tribes of Tierra del Fuego are accustomed to resort for the purposes of barter.

The two skulls, said to be males, measured by MM. de Quatrefages and Hamy, had a mean vertical index of 76·4, *i.e.*, 1·6 higher than their mean cephalic index; hence these authorities state that the Fuegian skull is hypsistenocephalic. In one of the eight skulls, the heights of which have been given by Prof. Flower and myself, the vertical index was greater than the cephalic (D. in my Table II.), and in the male skull figured by Mr. Huxley the vertical and cephalic indices were equal (73·9), but in the remaining six, three of which are presumably males, the vertical index was decidedly less than the cephalic; the mean of the series of ten crania was 73·87; hence they are metriocephalic.

[1] I may state that these views of the Fuegian skull have also been reproduced by MM. de Quatrefages and Hamy in the Crania Ethnica, p. 477, figs. 434–437.

The mean of the seven males was 73·4; of the three females 74·8, so that their vertical index was higher than the males, which is exceptional to the general rule in the two sexes.

The nasal and orbital indices have been determined in the skulls examined by MM. de



FIGS. 1, 2, 3, 4. Occipital, vertical, facial, and lateral, aspects of Fuegian skull in Mus. Roy. Col. Surgeons, London, No. 1025.

Quatrefages and Hamy, Prof. Flower, and myself. The mean nasal index in eight crania was 44·68, the minimum 41, the maximum 49·1, so that the average of this larger number was almost the same as in my smaller series, and confirms the leptorhine character of the nose of these people. The mean orbital index in nine crania was 91·1, the

minimum 84·2, the maximum 97; so that the megaseme character of the orbit is obviously the rule, although three specimens had mesoseme proportions.

The gnathic index has been determined in six specimens by Prof. Flower and myself. Owing to the higher index in the College of Surgeons specimens (ranging from 100·9 to 105·9) than in those collected by the Challenger, the mean of the entire series was 99·76, which places them in the mesognathic division, though, as the range was from 95 in a female skull to 105·9 in a male, individual skulls were either orthognathic, mesognathic, or prognathic.

The internal capacity has been taken in seven specimens by Prof. Flower and myself. The mean contents of the brain case were 1309 cubic centimètres, which places them in the microcephalic series, and the range was from 1190 in the skull B, which I have regarded as probably a female, to the male skull figured by Prof. Huxley, the capacity of which was 1420 c.c.

From the above analysis one may summarise the general characters of the Fuegian skulls as follows:—mesaticephalic, metriocephalic, mesognathic, leptorhine, megaseme, and microcephalic. This analysis of the whole series of skulls to the records of which I have had access agrees, except in the degree of projection of the upper jaw, with the results I had arrived at from the examination of the four specimens described in this Report.

During the years 1881 and 1882, a party of Fuegians, consisting of four men, four women, and three young children visited Europe, and were examined by numerous anthropologists in Paris, Germany and Switzerland.[1] They appear to have belonged to the Alaculoof tribe, and according to the Rev. Thos. Bridges[2] were not from Hermite Island, in immediate proximity to Cape Horn, as is stated by M. Topinard and by Prof. Virchow, but from Dawson Island to the north-west of Admiralty Sound. Measurements of the body, of the head and face are given independently by M. Manouvrier and by Prof. Virchow. The mean length of the head in the four men is stated by M. Manouvrier to be 196·7; that of the four women 193·2; the mean breadth is given as 157·2 in the men and 155 in the women; the cephalic index of the males is 79·9,

[1] A most interesting account of these people, as observed during September 1881, was given by M. L. Manouvrier, M. Topinard, and other French anthropologists, to the Société d'Anthropologie de Paris (*Bulletins*, Nov. 17, and Dec. 15, 1881, ser. 3, vol. iv. pp. 760, 841); also by Prof. Virchow to the Berliner Gesellschaft für Anthropologie, Nov. 14, 1881 (*Zeitschrift für Ethnologie*, Bd. xiii. 1881, p. 375). Prof. Bischoff has also written a short brochure on their physical and psychical characters, entitled "Die Feurländer in Europa," Bonn, 1882, and he has also communicated to *Sitzungsb. d. K. B. Akad. der Wiss.*, Feb. 4, May 6, 1882, two papers on the female genital organs and functions. In *Virchow's Archiv*, Bd. xci. p. 154 and p. 446, 1883, Dr. J. Seitz of Zurich describes the illness and death of five members of the troop, and gives an account of the *post mortem* appearances; he also contributes some observations on their habits and character. The Rev. Thos. Bridges states that only four returned to Fuegia, a youth, a middle-aged woman, and two children (see reference in next footnote). Dr. Seggel gave an account to the Anthropologische Gesellschaft of Munich of the eyes of the Fuegians (*Archiv für Anthropologie*, Bd. xiv. 349, 1883). In February 1884 Dr. Hyades, a member of the French Scientific Mission to Cape Horn, contributed to the *Bull. de la Société d'Anthropologie*, some observations on the Tekeenika tribe, more especially on their language, and as a supplement to his paper he translates one on their manners and customs by the Rev. T. Bridges.

[2] *South American Missionary Magazine*, Nov. 1, p. 254, 1882.

that of the females 80·2. Virchow from his measurements places the cephalic index in the men at 79, whilst that of the two women whom he examined is in the one case 79·6, in the other 80·6, with a mean of 80·1; the mean of the series of six heads was 79·4. Both these observers therefore agree in placing the mean cephalic index of these Fuegian heads in the highest term of mesaticephalism, or the lowest of brachycephalism, which is somewhat higher than the mean of 76·5 deduced from the eleven crania which have up to this time been examined. One can no longer therefore say that the Fuegians are as a whole a dolichocephalic race. The mean stature of the four men is stated by M. Manouvrier to be $1^{m}{\cdot}612$, *i.e.*, 5 feet $3\frac{1}{2}$ inches, whilst Virchow gives 1645 mm., *i.e.*, 5 feet $4\frac{3}{4}$ inches as the height of Hendrich the tallest of the men.

The question however arises, may there not be more than one race of people dwelling in the islands of the Fuegian archipelago? Herr von Böhr, who sailed in Magellans Strait in 1879,[1] examined the heads of some men who visited his ship in their canoe about 20 nautical miles west of Cape Froward. He states that the skull was elongated, conspicuously high, and tapering off from the sides towards the vertex in a ridge. He took the greatest breadth and length, "mit einem etwas groben Tasterzirkel," and gives the cephalic index of three men as respectively 70, 73, and 77, or a mean of 73·3. Although he admits that his callipers were somewhat coarse, yet his eye had recognised the longish or oblong form of the head in these persons, so that although his measurements may not have been absolutely correct, yet they are probably approximately so. These observations, together with the measurements of certain of the skulls referred to on p. 22, point to the presence of people with dolichocephalic heads amongst the Fuegians. The tallest of the men was 5 ft. 1 in., the shortest 4 ft. 10 in. The proximity of the archipelago to the part of the continent occupied by the brachycephalic Patagonians may perhaps have led to an intermixture of races, so that if, as is not impossible, the original stock of these islands was dolichocephalic, a measure of fusion of the two races may have led to the origin of a people whose heads have mesaticephalic proportions, more or less strongly pronounced according to the proportion in which one or other of the two original races preponderated.

That the inhabitants of Tierra del Fuego are not a homogeneous people has indeed been recognised by more than one traveller. Captain Fitzroy states[2] that the Yacanakunny in the north-east of the large island resemble the Patagonians in colour, stature, and clothing, whilst the Tekeenica, who live in the south-east, are low in stature, ill-looking, and badly proportioned. The Alikhoolip tribe are not unlike, though superior to, the Tekeenica, whilst the Yacanas partake of the peculiarities of both the Patagonians and Fuegians. Captain King also describes the wife of a Fuegian as from her size not

[1] Communication made to the Berliner Gesellschaft für Anthropologie, Jan. 15, 1881 (*Zeitschrift für Ethnologie*, Bd. xiii. p. 30, 1881). Dr. Essendorfer had also, on 30th March 1880, given (*Zeitschrift*, Bd. xii. p. 57) some information about the aspect of the Fuegians, but without any measurements.

[2] Voyage of the Adventure and Beagle, vol. ii. p. 137, 1839. Captain King's description is in vol. i. p. 55.

unlike a Patagonian. Mr. Darwin says[1] that the people of the Bay of Good Success "are a very different race from the stunted miserable wretches farther westward, and they seem closely allied to the famous Patagonians of the Straits of Magellan" (p. 205). And conversely amongst the Patagonians at Cape Gregory, he observed a man with his face painted in white rings and dots like a Fuegian (p. 232). Dr. R. O. Cunningham also observed[2] that the people of the northern part of the large eastern island, the Yacana-kunny, differed strikingly from the western tribes in their much larger stature and in their manner of life, which approached in some particulars to that of the Patagonians. He further expressed the opinion that the southern Fuegian tribes had at a distant period migrated southwards "in consequence of having been evicted from their original territory by more powerful aboriginal nations." The Rev. Thos. Bridges, so well known for his philanthropic and missionary labours amongst the Fuegians, states that the Yahgan people at Ooshooia, where the mission station is, are short of stature, and with short and small arms and legs, the average height of the men being 5 ft. $3\frac{1}{2}$ in., and the women $2\frac{1}{2}$ in. shorter. On the other hand, the Ona tribe at Sloggett Bay are very muscular and well grown people, and of the same stock as the southern Patagonians.[3] The language spoken by each of the tribes of the Yahgans, Onas, and Alaculoofs is also quite distinct, so that one tribe cannot understand another.

I should also state that a collection of Patagonian crania, obtained by M. F. P. Moreno[4] along with numerous flint and other stone implements from ancient cemeteries of the Téhuelches in the valley of the Rio Negro—cemeteries, the exact age of which could not be ascertained, but which from the absence of the bones of the horse in them were probably formed before the introduction of that animal into Patagonia—displayed variations in the relations of length and breadth, though the majority were distinctly dolichocephalic. M. Moreno gives the measurements of forty-five crania, eighteen of which were artificially deformed and twenty-seven without deformity. Of the normal crania eleven were males and sixteen females. The mean cephalic index of the males he places at 75·0; that of the females at 74·15, whilst the mean of the entire series is 74·44. From the table of extreme lengths and breadths I have calculated the cephalic indices in the twenty-seven normal crania, and find that no fewer than sixteen have a cephalic index below 75, and of these four are below 70, the lowest being 67;[5] seven range from 75 to 78·6, and four only are distinctly brachy-

[1] Naturalist's Voyage, ed. 1870.

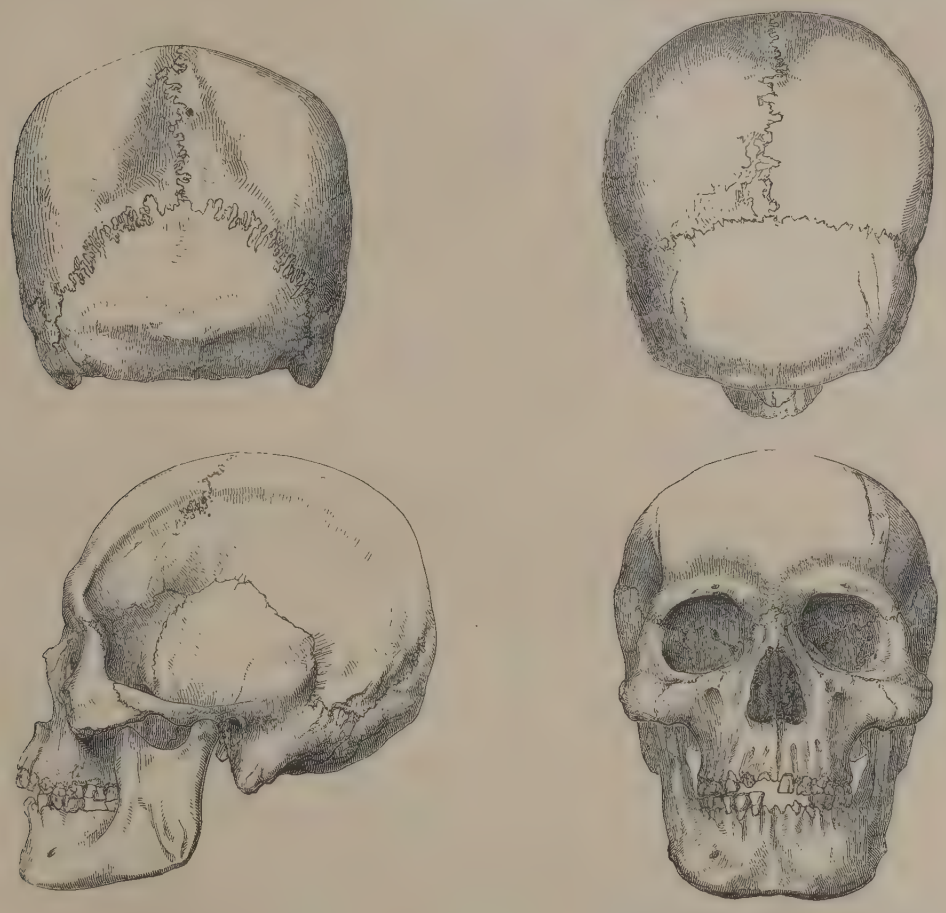
[2] Natural History of Straits of Magellan, 1871.

[3] *South American Missionary Magazine*, Jan. 2 and Oct. 2, 1882.

[4] Description des Cimetières et Paraderos préhistoriques de Patagonie, *Revue d'Anthropologie*, t. iii. p. 72, 1874. Lieutenant Masters has given an interesting account of the customs and physical appearance of the Races of Patagonia, especially of the Téhuelches, in the *Journ. of the Anth. Inst.* vol. i. p. 193, 1872.

[5] One of these skulls has its norma verticalis figured by MM. de Quatrefages and Hamy in the Crania Ethnica, p. 475, fig. 432—the norma facialis and norma lateralis in pl. lxxv. figs. 1 and 2.

cephalic, from 81·1 to 87·9. Prof. Virchow has also described[1] four skulls sent by Dr. Burmeister from the north side of the Rio Negro, two of which were deformed and two normal. Of the latter, one had a cephalic index of 77·4, the other of 70·3; the mean of the two being 73·85, which is almost the same as the much larger series collected by M. Moreno. Hence, it is clear that before the European colonisation of



FIGS. 5, 6, 7, 8.—Occipital, vertical, lateral, and facial aspects of Patagonian Skull from near the river Chupa.

South America a people with dolichocephalic heads inhabited that part of the continent which we now call Patagonia.

The single skull marked Patagonian brought home by the Challenger does not afford me sufficient material upon which to base any conclusion as to the cranial characters of the modern Patagonians. It is indeed open to some doubt if this be a genuine Patagonian, as in its general form and in some of its measurements it so closely resembled the Fuegian

[1] Communication made to Berliner Gesellschaft für Anthropologie (*Zeitschrift für Ethnologie*, Bd. vi. p. 51, 1874).

skull A. Its cephalic index is only 77·5, which is considerably below the mean of 85·3 of the seven Patagonian skulls (three females, four males) measured by Prof. Flower, in the Museum of the Royal College of Surgeons, two of which, however, are artificially deformed. It is also much below the skull of a Patagonian found in a tumulus near the river Chupa, cephalic index 89, figured by Prof. Huxley, whose figures for convenience of reference I have reproduced on p. 27,[1] and to the skull from Carmen, at the mouth of the Rio Negro, recently described by Mr. G. W. Bloxam,[2] the cephalic index of which was 92·6, in which, however, the index is without doubt increased by modification in the shape from occipital pressure. MM. de Quatrefages and Hamy also point out that the Puelches, the people who now occupy the valley of the Rio Negro, where the dolichocephalic race of the Téhuelches once resided, are remarkable for their brachycephalism. It may therefore be a fair subject for enquiry whether a dolichocephalic race did not precede in South America its present brachycephalic inhabitants, which race has been gradually displaced, though its descendants may yet be found in the Guaranis of Bahia[3] and in the Botocudos of Brazil, or pushed far to the southward in the dolichocephalic or, perhaps with some intermixture, also in the mesaticephalic people of the Fuegian archipelago. The difference between the modern Patagonian and the Fuegian is not one of head-form only. They differ also strikingly in their stature and mode of life, and the former in physical characteristics certainly, and probably also in intellectual, is obviously a much superior race to the latter.

AUSTRALIAN.

Plates II., VII. Tables III., IV., V., VI., XVIII., XIX.

Only three aboriginal Australian skulls were collected by the Challenger. One a male, probably from Queensland. A second, a male from Queensland, was obtained along with other bones of the skeleton from a collector. The third, a female from West Victoria, in the Camperdown district, inland from Port Fairy, was presented along with other bones of the skeleton by James Dawson, Esq.[4] In addition I have examined two skulls long in the Anatomical Museum of the University, and a considerable number of crania which I have been engaged for some years in collecting, and for which I am indebted partly to the kindness of W. G. Howitt, Esq. of Melbourne, and partly to that of several of my

[1] *Journal of Anatomy and Physiology,* vol. ii. p. 253. These figures have also been reproduced by Dr. Barnard Davis in his Supplement to the Thesaurus Craniorum, pp. 58, 59, 1875 ; and by MM. de Quatrefages and Hamy in Crania Ethnica, p. 468.

[2] *Journ. Anthrop. Inst.*, p. 28, Aug. 1882. Length 163 mm., Breadth 151 mm., Height 148 mm.

[3] Retzius in *Müller's Archiv*, 1849, and Ethnologische Schriften, p. 112, shows that the Guarani Indians are dolichocephalic. In the same *Archiv*, 1855, and in Ethnologische Schriften, p. 134, he gives the length and breadth measurements of the skull of a Pampas Indian, with a cephalic index of 88·4.

[4] A most interesting account of the customs, language, &c. of the natives of this part of Victoria has been given by Mr. Dawson in a quarto volume, Australian Aborigines, Melbourne, 1881.

pupils, of whom, from the number of specimens given to me, I may especially name Dr. Frederick Page, and Dr. G. More Reid.

The entire series consisted therefore of thirty-five crania, almost all of which were entire, and a large number possessed the lower jaw. They were from Queensland, New South Wales, Gipps Land, Victoria, South Australia, Lake Alexandrina, Alexandra Land, West Australia, North-West Australia, as far as the de Grey River, and Roebuck Bay.[1] They embrace specimens both of the coast tribes and of tribes much more inland.

With four exceptions they had all reached adult life, whilst some were more advanced in years; the four younger skulls ranged apparently from 16 to 18 years. Of the thirty-one adults twenty were apparently males and eleven females, whilst two of the four youths were males, the others probably females. In the male youths the basi-cranial synchondrosis was unossified. The 1st and 2nd permanent molars were erupted, but the wisdom teeth were still enclosed in their bony alveoli. It is remarkable that in one skull the upper lateral incisors were absent, apparently indeed never developed, and the canine sockets were in close proximity to the sockets for the central incisors. In the young

[1] The skull from Perth, West Australia, was dug up by John Thomson, Esq., Surgeon, along with the bones of the skeleton. The body was buried in the sitting posture, and the knees were the parts first exposed. The skull from the Macquarrie River district was found by Mr. D. Houison, 6 feet below the surface of a large mound of earth. The body, probably that of a chief, had been encased in Eucalyptus leaves 3 or 4 inches thick, and a layer of timber and bark was above the leaves. The trees facing the mound were marked and carved. The skull from Lake Alexandrina was got by Mr. Walter Dickson at the foot of a shea-oak tree, about 80 miles south of Adelaide and about 20 miles from the sea coast. In this district the natives smoke the bodies of their dead; they then swathe them in mats, bending the legs under the body, after which they place them in the forks of the shea-oak trees; as decomposition advances the bones fall to the ground. The Roebuck Bay skull, lat. 18°, was presented to me by Dr. F. Page, who states that the dead are left uncared for on the ground, but that the natives are more intelligent than those of the south-west coast; they make fishing lines and baskets, have heavy clubs and spears, which they do not throw, and have canoes in common use. They wear no clothing, are decidedly black, and are fine well-nourished men averaging 6 feet in height. Fish is their chief food. The Malays occasionally visit them. The Riverina skull, presented along with the skeleton by Dr. G. More Reid, was that of the chief of his tribe: he was said to be about 5 feet 10 inches high. The Coorong skull was obtained by Mr. Clement L. Wragge from a platform or funeral pile in thick tea-tree scrub adjoining the Coorong and mouth of the Murray; the body was rolled in coarse sacks. The Mudgee skull was dug up by Mr. R. Vandeleur Kelly near the banks of the Cudgegong River, New South Wales. The Mudgee tribe bury their dead in a large grave 3 or 4 feet deep, and make a circular mound over the grave, sometimes 10 feet in diameter; the corpse is placed in a sitting posture, with spears, boomerangs, &c., beside it. It is a custom of this tribe to knock out a front tooth, when a boy arrives at puberty. The skull from Eucla was that of a man said to be from 55 to 60, presented by Wm. Williams, Esq. (who also gave the male skull from Fowler's Bay, said to be a man of 40). The skull from the Wannon River was obtained by Mr. Pillean about 10 miles from Portland Bay and about 200 miles west of Melbourne. The Portland Bay skulls were dug up at the Hummocks, near Belfast and Warnamboot. The skull from the Margaret River, near Cape Leeuwin, says Dr. F. Page, was that of a man who had been a herdsman, and who stood 6 feet high, considerably above the average height of the men of his tribe, who are small, badly fed savages, dressed in skins and leading nomadic lives. Food is scarce with them. They live upon roots, with an occasional gorge of Kangaroo. Although close to the sea they do not fish with a net or line, nor do they make or use canoes. The natives of this district are of a mahogany colour, with long black hair and dark brown eyes. They bury the dead in the sitting posture and raise a tumulus over the grave. The Benalla skulls are from a place between the Goulburn and Murray Rivers, about 150 miles north of Melbourne; the male is said by Mr. James Grice, who dug them up, to be about 60, the female about 24. The specimen from the de Grey River was in the collection of the late Dr. Handyside, but has now been acquired for the Anatomical Museum of the University of Edinburgh.

females the basi-cranial synchondrosis was also unossified, the 1st and 2nd permanent molars were erupted, but the wisdom teeth had not come to the surface. In one of these a unicuspidate tooth occupied a cavity in the palatal plate of the left superior maxilla, behind the incisive canal and parallel and close to the intermaxillary suture. It lay horizontally, parallel to that suture, and with what seemed to be its crown directed backwards. The incisors, canines, bicuspids, and 1st and 2nd molars had all erupted in their proper order, so that this palatal tooth was a supernumerary *dens*.

It might seem scarcely necessary that I should enter into a minute description of the characters of the crania of the aboriginal Australians, as so much has been written on that subject by preceding craniologists; but as these skulls have been collected from so wide an area, and as the precise locality of collection has in most cases been noted, an examination and comparison of their most important features may not be considered to be out of place in this Report.

Norma verticalis.—In most of the skulls, especially the males, the ridge-like elevation in the sagittal region and the slope on each side outwards and downwards to the parietal eminence gave to the cranial vault a characteristic roof-like or ill-filled appearance; which was heightened by the ridge being not unfrequently prolonged forwards in the mid-frontal region. The greatest transverse diameter of the cranial box, both in the males and females, was in the great majority in the region of the squamous suture, and not near the parietal eminences. All the male crania were phænozygous, some slightly so, but others with widely arching zygomata. The females, with two exceptions, were phænozygous. In the youth's crania the zygomata were either invisible or barely visible in the norma verticalis. In the males the stephanic and asterionic diameters were equal or almost equal (within 2 mm.) in eight specimens. The stephanic exceeded the asterionic by more than 2 mm. in six, but was less than the asterionic in the remaining six. In the females the stephanic and asterionic diameters were equal or almost equal (within 2 mm.) in five specimens; the stephanic exceeded the asterionic in three, but was less than the asterionic in the remaining three. In the youth's crania the stephanic exceeded the asterionic by from 1 to 12 mm.

Norma lateralis.—Three of the males rested behind on the tips of the mastoids, one on the occipital condyles, the rest on the conceptacula cerebelli. The females all rested on the conceptacula, and one also on the condyles. The youths' all rested on the conceptacula. In the greater number of this series of skulls, therefore, the cerebellar region of the occipital bone bulged downwards. In the Portland Bay specimens it was almost horizontal, and the inion was brought low down in the occiput. The crania were all elongated. In all the male skulls, with one exception, both the frontal and parietal longitudinal arcs were considerably greater than the occipital; in the exceptional cranium, from Swan Hill, whilst the frontal arc was longer, the parietal was less than the occipital.

In five specimens the frontal and parietal longitudinal arcs were either equal or within 2 mm. of each other; in eight the frontal was in excess, often much greater, than the parietal; in seven the frontal was less, sometimes much less, than the parietal. In all the female skulls, with one exception, the frontal and parietal longitudinal arcs were greater than the occipital; in the exceptional cranium, from New South Wales, whilst the frontal was longer, the parietal was less than the occipital. In three specimens these two arcs were within 2 mm. of each other; in four the frontal arc exceeded the parietal; in four the parietal exceeded the frontal. In all the youths' skulls the occipital arc was less than either the frontal or parietal; in two the frontal was longer than the parietal; in two the parietal was longer than the frontal.

The male crania were, as a rule, massive and heavy, and with strong eminences and ridges at the glabella, supraciliary ridges, external orbital processes, temporal and occipital curved lines. The male skull from the Riverina weighed, with its lower jaw, 2 lbs. $6\frac{3}{4}$ oz. avoir., and other skulls weighed 2 lbs. and 1 lb. $15\frac{1}{2}$ oz. The adpressed character of the frontal bone above the ectorbitals, in such skulls as those from the Riverina, Eucla, Wannon River, a Queensland and a Murray River skull, was so striking, that in this character and in the projecting glabella they approximated to the well-known skull from the Neander Valley. The very prominent glabella in these specimens contributed materially to the great length, 200 mm., which some of them possessed. On the other hand, the mastoids were not so massive, nor had they such a downward projection as one finds in the male crania of some other races, so that it was the exception for a skull to rest behind on the tips of the mastoids. The projection of the glabella caused a marked depression at the fronto-nasal suture. In the female and young skulls the glabella had so little prominence that the glabello-occipital and ophryo-occipital diameters were either equal or differed but slightly from each other; whereas, in the male skulls they sometimes differed by as much as 4, 5, or even 6 mm. The nasal bones sloped forwards and upwards, were frequently small in size, and the bridge of the nose was concave forwards, usually low, rounded from side to side, and not elevated into a crest. The dimensions of the nasal bones were not taken in all the specimens, but in those that were measured they varied from 18 to 26 mm. in length, and from 6 to 10 mm. in greatest breadth. A very marked slope of the frontal bone upwards and backwards from the glabella was present in many of the male crania. In the female skulls the frontal region was much less sloping, the fronto-orbital region was much smoother and the fronto-nasal less depressed. In a few specimens, *e.g.*, the Wannon river and Eucla crania, the temporal fossa extended so far up the side of the skull that the highest part of the temporal ridge reached to between 3 and 4 cm. from the sagittal suture, and the temporal ridge itself was usually double.

In none of the crania was the nasal spine of the superior maxilla prominent; as a rule, indeed, it was feeble in both the male and female crania. The sides of the anterior nares,

instead of being almost perpendicular to the floor of the nose, and with a sharp edge, were rounded off and smooth where they became continuous with the nasal floor. This form of the anterior nares was especially marked in the skull from Roebuck Bay, in which also the nasal spine of the superior maxillæ was reduced to a faint tubercle. As the obliquity of the sockets of the incisor teeth was great in this skull, the length of the palate and the alveolar prognathism formed marked features in the facial aspect, and the rounded floor and sides of the anterior nares approximated in appearance to the nares of an anthropoid ape. In all the adult skulls, with four exceptions, the width of the posterior nares, measured immediately above the root of the hamular process of the internal pterygoid plate, was less than that of the anterior nares. The interzygomatic breadth invariably exceeded the stephanic, asterionic, and intermalar diameters. Except in one female, the intermalar diameter was greater than the stephanic. In thirteen out of eighteen adult male skulls the interzygomatic diameter exceeded the greatest parieto-squamous; whilst in five out of seven female skulls the inter-parietal exceeded the interzygomatic. The mean interorbital breadth in the males was 24·5 mm., the maximum 28 mm., the minimum 21 mm., whilst in the females the mean was 22 mm., the maximum 25 mm., the minimum 19 mm.

The orbits in the males were characterised both by the massiveness of the upper orbital border and by a peculiar breadth and curvature of the malar bone where it formed the outer boundary, which wanted the sharpness one sees in crania generally, so that in taking the transverse diameter of the orbit there was a difficulty in deciding on the exact point on which the callipers should be placed. In many male skulls the canine fossæ were remarkably deep, although the teeth were not shed, and the hollow was not due to absorption of the jaws from age. These hollows, conjoined with the boss-like supra-orbital and supra-nasal projections, and a sort of general undulatory outline of the orbital boundary, gave to the facial aspect a peculiar rugged and irregular appearance. In the female skulls the external orbital border showed little trace of the peculiarity above described, and the canine fossæ had no special depth.

The crowns of the teeth were large, and the incisors and canines approximated in size; when the cusps were not worn away, the molars were coarsely tuberculated. As a rule the grinding surface of the crowns was flattened from wear, and the dentine more or less exposed. A few teeth were affected with caries, and occasionally a tooth had been shed from age, and the socket absorbed. In a male skull from Queensland, in the Mudgee skull, and in one from the Murray, New South Wales, the left central incisor had been extracted in early life, and its socket absorbed; in a West Australian from Perth, the right central incisor had been similarly treated.[1] This practice of extracting

[1] In some of the skulls subsequently referred to on p. 46 of text a similar peculiarity was observed, viz. in a skull from Rockhampton the right central incisor, in another from the same locality, the left central incisor, and in a skull marked "New Hollander" the right central incisor had been removed.

a central incisor prevails therefore in tribes widely separated from each other, but is by no means general amongst the natives, as none of the other skulls showed it. In the skull from Port Curtis the left lateral incisor had apparently not been developed. In a female from Gipps Land a rudimentary tooth with two small cusps protruded in the dentary arcade behind the left upper wisdom tooth. In a female from Victoria the first premolar was crowded out of its place, and in front of the canine. The palatal tooth in a youth's skull has already been described, p. 30. In many of the crania the maxillary tuberosity had grown into a roughened mass which prolonged the dentary arcade from 1 to 1½ cm. behind the last molar tooth.

In almost all the crania, except those of the youths, there was a tendency to oblitera-

TABLE III.—AUSTRALIAN—MALES.

	Collection,	Chal. Queensland.*	Chal. Queensland.	Port Curtis, Queensland.	Riverina,* N.S.W.	Mudgee tribe, N.S.W.	Macquarrie River, N.S.W.	Swan Hill *b*. N.S.W.	Swan Hill *a*. N.S.W.	Wannon River, Victoria.	Portland Bay, Victoria.
	Age,	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Aged.
	Sex,	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.
	Cubic capacity,	1360	1283	1514	1297	1132	1210	1365	1318	1192	1250
	Glabello-occipital length,	189	193	198	200	182	187	190	184	192	200
	Ophryo-occipital ,,	186	190	196	195	180	185	189	181	186	198
	Basi-bregmatic height,	132	135	136	146	135	135	144	134	134	132
	Vertical Index,	*70*	*70*	*69*	*73*	*74*	*72*	*76*	*73*	*70*	*66*
	Minimum frontal diameter,	92	100	108	100	93	90	99	92	90	98
	Stephanic ,,	105	106	120	108	104	108	110	108	104	109
	Asterionic ,,	116	116	115	106	103	110	106	110	105	109
	Greatest breadth,	132*s*	134*s*	136*s*	132*s*	129*s*	129*s*	135*s*	134*s*	124*s*	123*s*
	Cephalic Index,	*70*	*69*	*69*	*66*	*70·5*	*69*	*71*	*73*	*65*	*61·5*
	Horizontal circumference,	540	540	547	545	511	521	532	520	508	540
	Frontal longitudinal arc,	132	143	135	150	133	132	138	123	137	135
	Parietal ,, ,,	141	137	148	140	124	131	116	130	128	130
	Occipital ,, ,,	105	121	111	120	113	110	125	114	105	114
	Total ,, ,,	378	400	394	410	370	373	379	367	370	379
	Vertical transverse arc,	300	304	307	301	282	288	302	290	277	275
	Length of foramen magnum,	35	31	35	31	33	34	37	35	37	37
	Basi-nasal length,	108	97	106	110	100	104	108	104	107	113
	Basi-alveolar length,	107	100	103	114	100	102	104	109	108	117
	Gnathic Index,	*99*	*103*	*97*	*103*	*100*	*98*	*96*	*105*	*101*	*103·5*
	Interzygomatic breadth,	134	130	136	149	134	134	137	144	138	...
	Intermalar ,,	122	122	122	135	124	120	122	123	124	120
	Ophryo-alveolar length,	95	84	90	96	88	87	87	83	92	85
	Naso-alveolar ,,	73	62	68	70	64	64	66	63	66	65
	Facial Index,	*70*	*64*	*66*	*64*	*65*	*65*	*63*	*58*	*66*	...
	Nasal height,	50	43	50	47	48	51	51	47	51	47
	Nasal width,	27	26	26	28	22	27	28	26	26	25
	Nasal Index,	*54*	*60·5*	*52*	*60*	*46*	*53*	*55*	*55*	*51*	*53*
	Orbital width,	40	38	41	43	38	39	40	39	42	41
	Orbital height,	38	30	37	33	34	34	36	31	31	30
	Orbital Index,	*95*	*79*	*90*	*77*	*89·5*	*87*	*90*	*79·5*	*74*	*73*
	Palato-maxillary length,	60	59	59	67	58	62	59	61	63	61
	Palato-maxillary breadth,	70	64	66	74	71	66	65	63	66	68
	Palato-maxillary Index,	*117*	*108*	*112*	*110*	*122*	*106*	*110*	*103*	*105*	*111*
Lower Jaw.	Symphysial height,	35	...	...	36	34	30	30	...	...	33
	Coronoid ,,	69	...	...	78	66	61	64	...	...	57
	Condyloid ,,	60	...	...	73	60	62	62	...	...	58
	Gonio-symphysial length,	105	...	...	107	92	91	91	...	...	98
	Intergonial width,	102	...	...	113	91	94	103	...	...	100
	Breadth of ascending ramus,	39	...	...	43	39	39	37	...	...	43

* With pelvis.

tion of the sutures of the cranial vault, the degree to which this had taken place varying in different specimens. The tendency to bone formation in these Australian skulls, which gave rise to their weight and other peculiarities, affected also the condition of the sutures, so as to occasion obliteration at an earlier age than is the case in European skulls. No skull was metopic, but in the male youth indications of a frontal suture traversing the glabella were seen. Small Wormian bones were present in the lambdoidal suture in a few skulls, but there was no example of an interparietal bone. In several crania the spheno-parietal articulation was reduced to less than 5 mm. In three the squamous-temporal and frontal articulated directly at the pterion, either on one or both sides; in

TABLE IV.—AUSTRALIAN—MALES.

	Collection,	Benalla, Vict.	Hobson's Bay, Vict.	Fowler's Bay, S. Aust. Aet. 40	South Australia Coorong tribe.	Alexandra Land.	Eucla,* W. Aust.	Perth,* W. Aust.	Cape Leeuwin. W. Aust.	De Grey River, N.W. Aust.	Roebuck Bay, Lat. 18°.
	Age	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.
	Sex,	M.	M.	M.	M.	M.	M.	M.	M.	M.	M.
	Cubic capacity,	1270	1336	1235	1400	1218	1334	1310	1356	1450	1044
	Glabello-occipital length,	183	190	190	200	187	200	189	194	198	180
	Ophryo-occipital ,,	181	188	188	196	182	197	185	191	197	178
	Basi-bregmatic height,	136	137	134	131	130	136	134	136	134	130
	Vertical Index,	*74*	*72*	*70*	*65*	*69*	*68*	*71*	*70*	*68*	*72*
	Minimum frontal diameter,	96	100	103	102	99	104	104	102	102	95
	Stephanic ,,	116	115	115	113	105	109	113	113	112	100
	Asterionic ,,	107	108	112	114	110	116	110	120	112	110
	Greatest breadth,	133*s*	136*s*	129*s*	137*s*	132*s*	132*s*	137*p*	134*s*	134*s*	122
	Cephalic Index,	*73*	*72*	*68*	*68·5*	*71*	*66*	*72·5*	*69*	*68*	*68*
	Horizontal circumference,	522	537	527	560	515	560	530	537	550	500
	Frontal longitudinal arc,	128	135	133	134	128	132	131	133	138	127
	Parietal ,, ,,	137	132	135	138	123	132	134	133	148	126
	Occipital ,, ,,	109	108	107	124	113	119	119	107	114	111
	Total ,, ,,	374	375	375	396	364	383	384	373	400	364
	Vertical transverse arc,	296	292	290	295	283	287	294	298	292	274
	Length of foramen magnum,	34	31	36	33	33	39	31	38	33	29
	Basi-nasal length,	102	111	106	105	106	109	102	112	105	100
	Basi-alveolar length,	108	108	105	109	106	106	102	108	105	108
	Gnathic Index,	*106*	*97*	*99*	*104*	*100*	*97*	*100*	*96*	*100*	*108*
	Interzygomatic breadth,	...	135	136	139	138	146	134	144	136	120
	Intermalar ,,	123	124	128	128	121	135	120	129	124	112
	Ophryo-alveolar length,	91	96	87	95	86	91	89	80	84	93
	Naso-alveolar ,,	68	74	66	70	66	71	66	60	60	71
	Facial Index,	...	*71*	*63*	*68*	*62*	*62*	*66*	*55*	*62*	*77*
	Nasal height,	48	56	49	51	48	51	50	48	47	55
	Nasal width,	29	27	25	28	27	26	25	26	26	28
	Nasal Index,	*60*	*48*	*51*	*55*	*56*	*51*	*50*	*54*	*55*	*51*
	Orbital width,	41	40	40	42	40	46	41	41	42	38
	Orbital height,	32	35	33	38	31	33	30	30	32	32
	Orbital Index,	*78*	*87·5*	*82·5*	*90·5*	*77·5*	*72*	*73*	*73*	*76*	*84*
	Palato-maxillary length,	65	61	62	66	62	63	58	59	64	68
	Palato-maxillary breadth,	66	70	63	65	69	70	65	66	69	68
	Palato-maxillary Index,	*101·5*	*115*	*102*	*98·5*	*111*	*111*	*112*	*112*	*108*	*100*
Lower Jaw.	Symphysial height,	32	33	...	34	36	32	32	32	31	33
	Coronoid ,,	68	63	...	71	66	68	64	62	67	65
	Condyloid ,,	68	59	...	65	55	63	62	56	57	64
	Gonio-symphysial length,	105	98	...	97	91	103	87	101	91	97
	Intergonial width,	105	103	...	97	91	101	86	98	88	91
	Breadth of ascending ramus,	41	39	...	37	35	40	38	42	38	...

* With pelvis.

two there were small epipteric bones. In a youth's skull from the Murray River the antero-inferior angle of the parietal was very elongated, and the parieto-sphenoid suture was only 4 mm. broad. In a male two small ossicles were in the palato-maxillary suture. Faint indications of a maxillo-premaxillary suture were occasionally seen on the palatal surface. The malar bone was not divided in any specimen. In one youth's skull, although the basi-cranial synchondrosis was open, one of the styloid processes was ossified to the temporal bone.

The vertical diameter of the os planum was in several instances short, and in the Cape Leeuwin, Roebuck Bay, Gipps Land, and Alexandra Land skulls, this part of the ethmoid terminated in a point anteriorly, so that the ethmoid and lachrymal barely

TABLE V.—AUSTRALIAN—FEMALES.

	Collection	E.U. A.M. N.S.W.	E.U. A.M. No. 67. N.S.W.	N.S.W. No. 1.	Lower Murray, N.S.W.	Gipps Land. No. 1.	Gipps Land. No. 2.	Gipps Land. No. 3.	Benalla, Vict.	Port-and Bay, Vict.	Chal. West* Vict.	Lake Alex., S. Aust
	Age,	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Ad	Ad.
	Sex,	F.	F.	F.	F.	F.	F.	F.	F.	F.	F.	F.
	Cubic capacity,	1088	930	1146	1098	1156	1140	..	1115	946	1192	1220
	Glabello-occipital length,	184	164	181	176	180	182	173	184	176	172	180
	Ophryo-occipital ,,	184	164	181	175	180	182	171	182	174	172	178
	Basi-bregmatic height,	122	110	128	128	124	123	...	130	122	124	130
	Vertical Index,	*66*	*67*	*71*	*73*	*69*	*67*	...	*71*	*69*	*74*	*72*
	Minimum frontal diameter,	96	84	92	93	94	90	93	98	86	88	94
	Stephanic ,,	103	98	106	107	107	99	102	110	95	100	105
	Asterionic ,,	106	94	100	104	107	108	103	108	95	104	105
	Greatest breadth,	130*s*	118*s*	130*s*	125*s*	132*s*	132*s*	128*s*	124*s*	119*s*	134*s*	131*s*
	Cephalic Index,	*71*	*72*	*72*	*71*	*73*	*72·5*	*74*	*67*	*68*	*78*	*73*
	Horizontal circumference,	510	455	500	493	501	505	488	502	484	488	508
	Frontal longitudinal arc,	125	113	126	126	122	113	118	121	117	119	124
	Parietal ,, ,,	121	116	114	121	128	128	120	120	119	126	120
	Occipital ,, ,,	110	111	120	110	110	112	...	113	104	105	111
	Total ,, ,,	356	330	360	357	360	353	...	354	340	350	355
	Vertical transverse arc,	268	254	282	275	274	275	278	273	253	280	278
	Length of foramen magnum,	36	28	30	31	34	35	...	35	33	36	34
	Basi-nasal length,	98	85	100	93	95	101	...	108	95	94	101
	Basi-alveolar length,	...	88	92	92	94	99	...	110	100	90	104
	Gnathic Index,	...	*103·5*	*92*	*99*	*99*	*98*	...	*102*	*105*	*96*	*103*
	Interzygomatic breadth,	...	...	121	116	127	...	...	125	124	124	130
	Intermalar ,,	...	...	109	104	115	112	...	116	114	106	116
	Ophryo-alveolar length,	...	70	81	75	73	82	...	82	89	82	90
	Naso-alveolar ,,	...	52	61	55	56	62	...	62	69	59	66
	Facial Index,	...	...	*67*	*64*	*57*	...	...	*65*	*72*	*66*	*69*
	Nasal height,	...	37	48	43	43	51	...	47	48	44	49
	Nasal width,	...	22	26	25	24	25	...	24	24	23	25
	Nasal Index,	...	*59·5*	*54*	*58*	*56*	*49*	...	*51*	*50*	*52*	*51*
	Orbital width,	...	34	35	38	39	41	...	39	38	36	37
	Orbital height,	...	29	33	35	32	37	...	33	36	33	35
	Orbital Index,	...	*85*	*94*	*92*	*82*	*90*	...	*85*	*95*	*92*	*95*
	Palato-maxillary length,	...	50	51	50	54	54	...	61	57	48	60
	Palato-maxillary breadth,	...	53	60	54	62	61	...	64	62	55	68
	Palato-maxillary Index,	...	*106*	*118*	*108*	*115*	*113*	...	*105*	*109*	*114·5*	*113*
Lower Jaw.	Symphysial height,	...	...	25	...	...	...	...	...	28	25	29
	Coronoid ,,	...	...	50	...	...	...	...	...	56	50	61
	Condyloid ,,	..	...	45	...	...	...	...	...	52	54	57
	Gonio-symphysial length,	...	..	85	...	...	...	...	...	86	83	89
	Intergonial width,	...	...	88	...	...	...	...	...	91	82	86
	Breadth of ascending ramus,	...	...	32	...	...	...	...	...	30	...	38

* With pelvis.

articulated with each other, and the orbital plates of the frontal and superior maxilla were almost in contact. The occurrence of this arrangement in the Roebuck Bay skull added another to the ape-like characters of this cranium referred to on p. 32. In the Perth skull the orbital surfaces of the two lachrymals were remarkably small, the maximum length being 11 mm. and the breadth 6 mm. In three males and one female the anterior palatine foramen was unusually large, reaching 5 mm. in its transverse

TABLE VI.—AUSTRALIAN—YOUNG SKULLS.

	Collection,	Murray, N. S. W.	N. S. W. No. 2.	N. S. W.	Lower Murray, N. S. W.
	Age,	Aet. 16.	Aet. 16.	Aet. 18.	Aet. 18.
	Sex,	M.	M.	F.	F. (?)
	Cubic capacity,	1295	1252	1066	1265
	Glabello-occipital length,	188	183	182	182
	Ophryo-occipital ,,	187	181	180	182
	Basi-bregmatic height,	128	129	133	131
	Vertical Index,	*68*	*70·5*	*73*	*72*
	Minimum frontal diameter,	98	90	98	91
	Stephanic ,,	109	108	112	108
	Asterionic ,,	108	104	100	103
	Greatest breadth,	129*s*	127*p*	127*p*	131
	Cephalic Index,	*69*	*69*	*70*	*72*
	Horizontal circumference,	520	504	502	501
	Frontal longitudinal arc,	134	129	135	127
	Parietal ,, ,,	133	120	141	130
	Occipital ,, ,,	121	112	104	116
	Total ,, ,,	388	361	380	373
	Vertical transverse arc,	281	283	289	283
	Length of foramen magnum,	31	31	32	29
	Basi-nasal length,	95	102	95	100
	Basi-alveolar length,	95	106	98	100
	Gnathic Index,	*100*	*104*	*103*	*100*
	Interzygomatic breadth,	120	118	...	117
	Intermalar ,,	108	106	109	104
	Ophryo-alveolar length,	72	80	77	78
	Naso-alveolar ,,	52	61	70	63
	Facial Index,	*60*	*68*	...	*67*
	Nasal height,	40	45	49	46
	Nasal width,	21	21	24	29
	Nasal Index,	*52·5*	*47*	*49*	*63*
	Orbital width,	38	37	38	37
	Orbital height,	30	32	31	32
	Orbital Index,	*79*	*86·5*	*82*	*86·5*
	Palato-maxillary length,	53	58	60	55
	Palato-maxillary breadth,	65	62	65	64
	Palato-maxillary Index,	*123*	*107*	*103*	*116*
Lower Jaw.	Symphysial height,	...	28	28	28
	Coronoid ,,	...	53	53	52
	Condyloid ,,	...	46	51	45
	Gonio-symphysial length,	...	86	80	83
	Intergonial width,	...	84	...	85
	Breadth of ascending ramus,	...	38	34	29

diameter. I did not see in any of the crania an exostosis within the external meatus; a third occipital condyle; a paramastoid process, except in the most rudimentary form; or a complete pterygo-sphenoid foramen, although in a Swan Hill skull such a foramen was almost formed. In several specimens a suture extended from the infra-orbital foramen through the lower border of the orbit into the infra-orbital canal.

The lower jaw was not so strongly developed as might have been expected from the massiveness of the skull generally. In the Riverina and some other males the rami were large, the angle almost rectangular, and the chin square; but the mental region was often feeble and with scarcely any forward projection at its lower border. The intergonial width was sometimes greater, at others less than the gonio-symphysial length. The coronoid height was, with few exceptions, greater than the condyloid; the sigmoid notch had not any great depth, though it was not so shallow as in the Bush crania.

The mean cephalic index of the thirty-one adult crania was 70; that of the twenty males was 69; that of the eleven females was 72. Each skull was dolichocephalic, with the sole exception of the female from Victoria presented by Mr. J. Dawson, the length-breadth index of which was 78. Setting this skull on one side, the ten female crania ranged from 74 to 67, whilst the males ranged from 73 to 61·5. The mean cephalic index of the adult females was therefore greater than that of the adult males. The mean length-breadth index of the four youths' crania was 70. A most noticeable feature in these Australian skulls was the great length of so many of the male crania, four of which were each 200 mm. long, and eight others were between 190 and 200 mm. They are indeed the longest normal skulls that have been measured in the course of this enquiry. The adult male from Portland Bay with a length of 200 mm., had a breadth of only 123 mm. All the sutures of the cranial vault were ankylosed, and from the very complete obliteration of the sagittal and the ridge-like elevation of its region, together with the scaphocephalic form of the skull, it is not unlikely that this suture may have been prematurely closed, which would account for the little breadth of the cranium and its abnormally low cephalic index, 61·5.[1] In the male from the Wannon River, with the low index of 65, and in the Riverina skull with an index of 66, there was no premature synostosis, although the sagittal suture was partially obliterated through age. The female skull from Portland

[1] In the Anatomical Museum of the University is a very characteristic adult scaphocephalic skull, which I described and figured in the *Natural History Review*, vol. iv. p. 94, fig. 1, 1864. Its glabello-occipital length was 202 mm., its transverse diameter 130 mm., and its cephalic index 64. The well-known traveller Baron de Miklucho-Maclay describes in the *Proc. Linn. Soc. New South Wales*, vol. viii. p. 401, pl. xix., 1883, a very dolichocephalic skull collected in Queensland, but now in the Australian Museum, Sydney. The cephalic index is 58·3 the vertical index 64·8. The glabello-occipital length is 204 mm; breadth 119 mm.; height 131 mm. He states that the skull shows no evidence of deformity, but in his description and figure he points out that the sagittal suture is completely obliterated. This character combined with the scaphocephalic shape of the skull leads me to think that its length and narrowness were due to premature synostosis of the sagittal suture. Dr. Barnard Davis has also described and figured (*Natuurkund. Verhandel. Holland. Wetensch. Haarlem*, 1865) a very interesting scaphocephalic skull from the Macleay River district, N.S.W., the length of which was 210 mm., the breadth 121 mm., and the height 134 mm. The cephalic index was only 57, and the vertical index was 63. I may also refer to the scaphocephalic skull of an Egyptian mummy described by me in the *Edin. Med.*

Bay, which was only 119 mm. in its parietal diameter, had also a complete obliteration of the coronal and sagittal sutures, and a shape approximating to the scaphocephalic.

The mean vertical index of thirty adult crania was 70·4; that of the twenty males was 70·6, that of ten females was 69·9, so that the difference between the two sexes was very slight. The mean basi-bregmatic height of twenty males was 135 mm.; the minimum in two specimens was 130, the maximum in one 146; in two specimens only the maximum exceeded 140 mm. The mean basi-bregmatic height of ten females was 124 mm.; only two specimens reached 130 mm., and one was as low as 110 mm. The difference, therefore, between the height of the two sexes was very remarkable, andgreatly to the advantage of the males. In eight of the male crania the actual height was either equal to or within 2 mm. of the greatest breadth in the same skull; in nine skulls the height was distinctly greater than the breadth, in two the height was less than the breadth. In the female skulls the height and breadth were almost equal in one specimen; the height was greater than the breadth in three, but less than the breadth in six. Hence in the females it was not only the rule for the basi-bregmatic height to be less than the greatest breadth, but the mean altitudinal diameter was in relation to the length less than the transverse diameter. The skulls were tapeinocephalic.

The mean gnathic index of twenty-nine skulls was 100·3; that of twenty males was 100·6, that of nine females was 99·7; the average for each sex, as well as for both sexes collectively, brought this index into the mesognathous series according to the division employed by Prof. Flower. The maximum index in the males was 108, and seven specimens were 103 or upwards, *i.e.*, had a decidedly prognathous index, whilst eight were mesognathous and five were orthognathous. The maximum index in the females was 105, and three specimens only were 103 and upwards. In the four youths' crania the mean gnathic index was 101·7, being somewhat higher than that of the adults.

The mean nasal index of twenty-nine skulls was 53·4; that of twenty males was 53·47, that of nine females was 53·2. The average for each sex, as well as for the two sexes collectively, was platyrhine. The highest index in the male series was 60·5, and twelve specimens were 53 or upwards; one the Mudgee skull was 46, *i.e.*, in the leptorhine series, whilst seven were mesorhine. The highest index in the female series was 59·5, and four were above 53, whilst the remaining five were mesorhine. The mean of the four youths was 52·9, *i.e.*, on the verge of the platyrhine group.

The mean orbital index was 84; that of twenty males 81·4, that of nine females 90. The average on the two sexes collectively was mesoseme; that of the males microseme, that of the females megaseme. In the males twelve were below 84, *i.e.*, microseme; three were mesoseme, whilst five were megaseme. In the females the whole with one exception were megaseme. The mean orbital index in the youths' crania was 83·5.

Journ., July 1865, the cephalic index of which, calculated on a parietal breadth of 4·3 inches, was only 53, but, calculated on a mastoid breadth of 4·8 inches, was 59.

The mean palato-maxillary index was 109; that of twenty males 108·7, that of nine females 111, so that they were somewhat less dolichuranic than the males. In one male the palato-maxillary length was 1 mm. greater than the breadth, in one the length and breadth were equal, in four the breadth exceeded the length by not more than 3 mm., and in one only was the breadth greater than the length by more than 10 mm. In two females the breadth was only 3 mm. greater than the length, and in one only was the breadth as much as 9 mm. greater than the length. In the youths' crania the mean palato-maxillary index was 113·5. As a rule those crania that possess a low palato-maxillary index have at the same time a high gnathic index. Thus the male Coorong from Adelaide with p. m. index 98·5 has a gnathic of 104; the male from Roebuck Bay with p. m. i. 100 has a gnathic 108; the male from Benalla with p. m. i. 101·5 has a gnathic 106. In these cases a dolichuranic palate is associated with prognathism, and the prognathic condition is largely due to a forward projection of the alveolar border in the incisor region. In all these cases the palato-maxillary region was not only long relatively to its breadth, but its actual length was considerable, and in the Roebuck Bay specimen it reached 68 mm. Some others, however, with long palato-maxillary regions and high gnathic indices, had not such low palato-maxillary indices, owing to the greater breadth of the region, and in these skulls the palate was large in both dimensions. I may especially name as examples the magnificent male skull from the Riverina, the palato-maxillary region of which was 67 mm. long, the gnathic index was 103, and the palato-maxillary was 110; the skull from the de Grey River with a palato-maxillary length 64, a gnathic index 100, and a palato-maxillary index 108. In the Mudgee skull the gnathic index was also 100, but the palato-maxillary index was as high as 122, for the palate was only 58 mm. long, whilst its breadth was 71 mm.—the broadest palate in the series of Australian skulls, except the Riverina specimen. In such cases the degree of prognathism is probably due to some other cause than a mere projection of the alveolar border.

The mean cubic capacity of thirty adult crania was 1230 c.c.; that of twenty males was 1293·7; that of 10 females was 1103; the males ranged from 1514 c.c. to 1044 c.c.; the females from 930 c.c. to 1220 c.c.; the mean of each sex was therefore microcephalic, and only five male skulls exceeded 1350 c.c., the upper limit of the microcephalic series.

The sexual characters were strongly marked in the Australian crania. The much smaller size and capacity of the female skull, its comparative lightness, the feebleness of its ridges and processes, more especially the glabella; its low basi-bregmatic height and the high orbital index, all constituted important features of difference between the female and the male skulls.

These Australian skulls were in their mean proportions dolichocephalic, tapeinocephalic, phænozygous, mesognathic, platyrhine, mesoseme, dolichuranic, and microcephalic.

Since the publication by Blumenbach, in his third and fourth Decades,[1] of figures and

[1] Göttingen, 1795, 1800.

descriptions of the two New Holland skulls which were presented to him by Sir Joseph Banks, and of the description and figures by W. Gibson[1] and Alex. Monro, *tertius*,[2] of the skull of a New Hollander, the craniology of the aborigines of Australia has excited so much attention that a very extensive literature is now in existence. As the task of making an analysis of this literature, of naming the various writers, and of drawing up a comparative description of the skulls of the different tribes that have been examined, has already been so admirably performed by MM. de Quatrefages and Hamy, in the Crania Ethnica it is unnecessary for me to travel over their ground. Since the publication of their chapter on the Australian crania, however, two additional important contributions on the subject have been made by Prof. Flower, viz., the measurements of the skulls in the Museum of the Royal College of Surgeons[3] and a lecture on the Native Races of the Pacific,[4] also some minor papers by other writers, which have given further material for comparison.

It may now, therefore, be useful to compare the general results which I have arrived at from the examination of the Australian crania described in this Report with those of the above eminent craniologists. MM. de Quatrefages and Hamy give 71·19 as the mean cephalic index deduced from eighty-two observations on both male and female skulls (p. 321), many of the measurements of which were not made by themselves, but collected from the writings of their predecessors. They give, however, detailed measurements of thirty-eight skulls, which they divide into two types. The first type, consisting of thirty-one skulls, which represents the ordinary form of Australian cranium, they divide into coast tribes and tribes from the interior. Belonging to the coast tribes were fourteen male skulls, with a cephalic index of 69·89, and ten females with an index of 72·57. Belonging to the tribes of the interior were four males, C. I. 71·2, and three females, C. I. 73·74. The second type they name dolicho-platycephalic, from the length and lowness of the cranium; four male skulls belonging to it had a cephalic index 69·27, and three females, C. I. 72·37. The mean of the entire series of thirty-eight crania was 71·5. Prof. Flower does not propose any division into types of the fifty-four crania the characters of which he has analysed in his Native Races. Forty-nine of these were adults,—twenty-six males, nineteen females, and four doubtful. The male adults had a cephalic index 71·2, the females 72·3, the mean of the series being 71·75. These skulls, with three exceptions, range from 67 to 74, and of the exceptions one has an index of 75, one of 76, and one of 78. It should be remembered, however, that Prof. Flower excludes the glabella in his measurement of the antero-posterior maximum; if this had been included it is probable that one, if not two, of the exceptional crania might have been included with the rest in the dolichocephalic category. He

[1] Dissertatio de forma ossium gentilitia, Edinburgh, 1809.

[2] Outlines of the Anatomy of the Human Body, vol. i. p. 379, pl. xx. fig. 2; vol. iv., Edinburgh, 1813.

[3] Catalogue, Osteological series, 1879.

[4] *Proc. Royal Inst. of Great Britain*, May 31, 1878.

refers also to ten male skulls, which he measured in the Army Medical Museum at Netley, with a mean index of 72, and he lays down the general proposition that the average cranial index of the Australian skull is 72, or slightly less, and that they are therefore to be placed among the most dolichocephalic of races.

The mean cephalic index of the thirty-one adult crania measured in this Report was only 70, that of the twenty males 69; of the eleven females 72, but one of the female skulls had an index of 78, and it may be a question if this woman was of pure aboriginal blood. My average is therefore less than that of the above observers, which is to be accounted for in part by a considerable proportion of my crania possessing so great an antero-posterior maximum, in part by two of the skulls being unusually elongated, apparently by premature sagittal synostosis, but still more by my longest measurement always including the glabella, which formed so marked a projection in the majority of the male skulls, and by including which the dolichocephalic character of the crania is necessarily increased. My observations agree with those of my predecessors in giving to the female Australian skull a higher length-breadth index than to the male skull.

The mean basi-bregmatic height of forty-five specimens (apparently of both sexes) referred to by MM. de Quatrefages and Hamy (p. 323) was 135 mm. The fourteen male skulls of the coast tribes, in their 29th Table, had the same average height, whilst the ten females were only 131; the four males from the interior again were 141, the females 133; whilst of their dolicho-platycephalic group of crania, the four males were only 124 mm., but the three females were 127. They place the mean vertical index of the whole series of forty-five crania at 73·36, whilst that of the series of thirty-eight skulls recorded in their 29th Table is 71·7, the males being 70·3, the females 73·1. I have extracted from Prof. Flower's catalogue the basi-bregmatic height of thirty-nine males and of twenty-four females. The mean height of the former is 133 mm., that of the latter 126·5 mm. Prof. Flower himself places the vertical index in the male skulls at 72, in the female at 71·1, and in the whole series at 71·5; but in the ten male skulls in the Netley Museum the mean is 74.

If the vertical index in my series of crania be compared with that obtained by the above observers, it will be seen to be less than theirs, viz., 70·4 as against 71·7 and 71·5, which is without doubt owing to the glabella being included in my antero-posterior maximum but not in theirs. My observations accord with those of Prof. Flower in giving to the females a less vertical index than to the males, and we are both in marked contrast to the computations of MM. de Quatrefages and Hamy, in whose 29th Table the height index of the females exceeds that of the males in the proportion of 73·1 to 70·3. This statement by the French craniologists is so opposed to the experience of others that one is tempted to ask if in the drawing up of their table some error has not accidentally been made in their computations.

Prognathism, as estimated by the relative proportions of the basi-nasal and basi-

alveolar diameters, is not a necessary condition of the Australian skull. Prof. Flower places (New Cat.) the gnathic index of fifty-one specimens at 103·6 which brings them just within the prognathic division, but in his "Native Races" he states that there is considerable individual variation in these crania, as in five out of forty-two specimens the basi-alveolar diameter was less than the basi-nasal, and in seven specimens these two diameters were equal. The range of individual variation in my series of crania was from 92 in a female to 108 in a male skull, and the mean gnathic index was not so great as in the College of Surgeons specimens, so that the average was mesognathic. In the College of Surgeons series this index in the females was nearly 105, and more than in the males, where it was 103; but in my series the male average of 100·6 was greater than the female average of 99·7.

The mean nasal index obtained by MM. de Quatrefages and Hamy, by Prof. Flower, and by myself, places the Australian skull in the platyrhine division, but whilst the average of thirty-one skulls measured by the first named was 57·9, and that of Prof. Flower was 56·9, my average was considerably lower, only 53·5. Of the twenty-nine specimens which I measured, sixteen were platyrhine, twelve were mesorhine, and one was leptorhine. The presence of a leptorhine nose amongst the Australians is so rare that the authenticity of any specimen possessing this character requires to be well established. Of the authenticity of the skull of the Mudgee tribe, with its nasal index only 46, there can be no question. The circumstances under which it was got are related in the note p. 29, and, moreover, it was one of the skulls from which an incisor tooth had been extracted at puberty. The anterior nares in this specimen were not only narrow in relation to the height, but their absolute width was only 22 mm. The skull of a Hobson's Bay native had also a nasal index of only 48, one from Gipps Land 49, specimens from Perth and Portland Bay of not more than 50, Roebuck Bay 51[1], and all these were genuine Australian crania. Hence individual crania may possess a much lower nasal index than has usually been ascribed to the skulls of this race.

The mean orbital index of thirty-one skulls in MM. de Quatrefages and Hamy's table is 78·81, that obtained by Prof. Flower from fifty-one skulls is 80·9. These observers, therefore, have placed the Australian skull in the microseme series, which corresponds with my measurements of the male skulls; but owing to the megaseme proportions of so large a number of my female skulls, my average of the whole is raised to 84, which brings them just within the mesoseme series. In MM. de Quatrefages and Hamy's table, as well as in my own, the female index is considerably higher than the male, more so indeed than seems to have been obtained by Prof. Flower in his measurements, who in his "Native Races" places the male orbital index at 81·8, and the female at 82·9.

[1] Although the Roebuck Bay skull has a nasal index of only 51, *i.e.*, was mesorhine, yet the width of the anterior nares 28 mm., was only 1 mm. less than the widest of all the crania measured. Its diminished index was therefore due to the height of the nose 55 mm., which, with one exception, reached its maximum amongst the Australians in this specimen.

I am not aware of any other observations than my own on the palato-maxillary index in the Australian skull, which, as is shown on p. 39, is dolichuranic.

In their cubic capacity the Australian skulls are microcephalic. The average obtained by MM. de Quatrefages and Hamy is 1269 c.c., that by Prof. Flower is 1298, and that by myself is 1230; results which closely approximate, and definitely establish the microcephalic character of these people. We are also in accord in placing the capacity of the female skull as distinctly below the male. As far as the capacities of the individual skulls have been recorded, it is clear that not only is the mean of the race a low one, but that individual skulls do not attain a high capacity, such as one sees in the more cultivated races. Thus in Prof. Flower's series, thirty-two of which were gauged, only eight specimens were 1400 c.c. and upwards, and the highest of these was 1460 c.c.; whilst in my series of thirty-four crania, only three specimens were 1400 c.c. or upwards, and the highest of these, a male from Port Curtis, Queensland, was 1514 c.c.

From the above analysis the general characters of the Australian skulls may be summarised as follows:—markedly dolichocephalic, tapeinocephalic, not strongly prognathic, as a rule platyrhine, microseme or mesoseme, dolichuranic and microcephalic.

It is generally admitted that the northern and north-west coasts of Australia have been visited by both the Papuans and the Malays, and it is possible that the Polynesians may also have landed on the north-east coast. It is not unlikely that small colonies of these races may have been established on the Australian sea-board, and that there a certain local intermixture with the aboriginal Australian people may have taken place. Putting aside, however, these local and occasional admixtures, the question has been discussed by various travellers and anthropologists, if the Australians are a homogeneous people, or if the aborigines of the great island-continent consist of more than one race.[1] I need not enter into a full analysis of the evidence which has been advanced on the one side or the other, but may content myself with referring to two or three prominent writers.

Dr. Martin describes[2] from personal observation the natives of the district of Roebuck Bay in the North West, and states that those of the interior excel those of the sea coast in bodily structure. They are more muscular, taller, and apparently more intelligent; the profile more resembling that of a Polynesian than that of an Australian proper. They are however, black, and the hair is in spiral locks about three or four inches in length, wavy-crisp or frizzled, though not strongly, and jet-black. He gives the measurements of one skull, length 7·23 inches, breadth 5·31, facial angle 94°, upper jaw prognathic so as to give a very oblique insertion to the teeth. Dr. Topinard after a comparison of the

[1] In the Journal of the Anthropological Society of London, p. xxxii., published in the *Journ. of Anthrop.*, 1870, is a short report of a communication made by Dr. Carter Blake, from which it would appear that he considered three types of Australian skull to exist. The report is a mere abstract and without detail. See also Mr. Staniland Wake in *Journ. of Anthrop.*, 1871, and *Journ. of Anthropological Instit.*, vol. 1. 1872.

[2] *Journal of Royal Geographical Society*, vol. xxxv. p. 283, 1865.

descriptions of numerous travellers comes to the conclusion[1] that originally two distinct ethnological elements were indigenous to Australia. The one dolichocephalic, tall in stature, with robust and well proportioned bodies, long, straight, and smooth hair, and with the skin chocolate coloured. The other yet more dolichocephalic, of smaller stature and less robust, the skin black, the hair crisp and frizzly, the jaw very prognathic, and of less intelligence than the preceding. He thinks that the pure type of the inferior race is now extinct, but that it is preserved amongst many of the women of the tribes, and that the present people are the result of the crossing of the inferior and superior races.

On the other hand a very competent observer, Mr. R. Brough Smyth,[2] whilst making allowance for the local infusion of Papuan, Malay, or even Chinese blood, states that throughout Australia the natives exhibit a general conformity to one pattern as regards features, colour, and mental characters, so that "a man from Southern Gipps Land would be recognised as an Australian by the inhabitants of Port Essington, and a native of King George's Sound would be surely known if taken to York Peninsula." Prof. Giglioli also thinks[3] that the idea of a woolly haired race in Australia is due to the loose way in which the terms woolly and crisp have been used by explorers who were not anthropologists. With these different views before us, it will not be without interest to examine the collection of crania just described, to see if they present such diversities in form as might fairly be regarded as racial, and at the same time to ascertain what has been said on this matter by preceding craniologists.

Professor Huxley described and figured, about twenty years ago,[4] an Australian skull from Western Port which differed from the majority of Australian crania in being remarkably depressed at the vertex, and at the same time considerably elongated,[5] and he referred to other skulls from South Australia which possessed similar characters. He directed attention to certain features of resemblance between these crania and the Neanderthal skull. In a later work he has figured[6] one of these South Australian crania from near Adelaide (No. 5334 Cat. Roy. Col. Surgeons) and has again called attention to the Australoid character of certain ancient European crania. Prof. Flower in his new catalogue has given some of the dimensions of this Adelaide skull (No. 1072 New Cat.), which, with a length of 190 mm. possesses a cephalic index 70·5 and a vertical index of only 65·3. MM. de Quatrefages and Hamy, in an early fasciculus of the Crania Ethnica, on human fossil races, have discussed at some length (p. 39 *e.s.*) these conclusions of

[1] Étude sur les Races indigènes de l'Australie, *Bull. Soc. Anth.*, Paris, t. xii. p. 211, 1872. Also a critical review on the Australian Races in *Revue d'Anthropologie*, t. i. p. 298, 1872. Also in his Anthropologie, *op. cit.*

[2] The Aborigines of Victoria, London, 1878, vol. i. p. xvii. Mr. Smyth was for many years Secretary of the Board for the protection of the Aborigines.

[3] Viaggio intorno al Globo della corvetta "Magenta," Milan, 1876 ; quoted by MM. de Quatrefages and Hamy, p. 300.

[4] Man's place in Nature, p. 155, 1863.

[5] Prof. Flower has given in his new catalogue, p. 187, the dimensions of this skull from Western Port, from which it can be seen that the height 131 mm. slightly exceeded the breadth 130 mm. The vertical index was 73·6, the cephalic 73·0. The length was 178 mm.

[6] Prehistoric remains of Caithness, 1866, p. 131, figs. 62–65.

Prof. Huxley's, and agree with him in recognising an elongated and depressed skull as occasionally occurring in collections of Australian crania. This type they say is not widely diffused, and occurs especially in the Adelaide district, although specimens of a similar kind have been procured from other coast tribes. To crania of this type, whether they occur in the Australian or other races, they have given the name of dolicho-platycephalic. In a subsequent chapter (p. 300 *e.s.*), whilst they regard it as undoubted that in some parts of Australia different ethnic types are accidentally juxtaposed, and more or less fused, yet that, judging by the crania, the Australians proper are none the less one race, and that the differences seen in the crania are sexual rather than ethnic.

They give (p. 317) as an illustration of the dolicho-platycephalic type of skull a specimen presented by M. Erklund to the Museum Retzius (type No. 2). It differs, they say, from the ordinary type (No. 1) of Australian skull in having heavier supraciliary ridges, a much more depressed and more receding forehead, in a general flattening of the cranial vault, in a more considerable backward projection of the occiput, in a very abrupt change of curvature above the occipital protuberance, and in the almost complete horizontality of the base. This skull is markedly dolichocephalic. The antero-posterior diameter is 195 mm.; the greatest transverse diameter only 126 mm.; the basi-bregmatic diameter 125 mm. The length-breadth index is 64·6, the vertical index 64·1. They contrast these indices with those of a skull belonging to the ordinary Australian type, No. 1, in which they are respectively 67·0 and 73·19.

Prof. Flower in his Native Races refers to the collection of the College of Surgeons as containing a number of skulls belonging to a tribe from the neighbourhood of Adelaide of exceptionally depressed form, and in his Catalogue he gives their measurements as well as those of the other skulls in that collection. I have analysed his measurements of the Australian skulls, so far as regards the relative proportions of the cephalic and vertical indices, and find that of the sixty-four specimens, twenty-eight, viz., eleven males and seventeen females, had the vertical index less than the cephalic; six, viz., four males and two females, had their indices equal; whilst in thirty crania the vertical index was greater than the cephalic, and of these, twenty-two were probably males and eight females.

In the Thesaurus Craniorum and Supplement thereto by the late Dr. Barnard Davis,[1] the cephalic and vertical indices of the Australian skulls in his collection are recorded. I find that, after discarding those whose form had been altered by synostosis, or whose authenticity was somewhat doubtful, there remain twenty crania in which the relations of breadth and height to the length are stated. Of these seven, viz., five males and two females, had the vertical index less than the cephalic; in one, a female, the two indices were equal; and in the remaining twelve, eleven males and one female, the vertical index was greater than the cephalic.

[1] London, 1867 and 1875.

Since the previous part of this Report on the Australian skulls was in type, I have had the opportunity of examining fourteen additional Australian adult crania, seven of which were males, four females, and three doubtful, though probably females. These specimens, so far as the localities were known, were from Curtis Island, Moreton Bay, and Rockhampton in Queensland, from the neighbourhood of Sydney and Maitland in New South Wales, from the interior of South Australia and from the Milang tribe, Lake Alexandrina district.[1]

When these specimens are included along with the thirty adult skulls, the length, breadth, and height measurements of which are recorded in Tables III., IV., and V., my own observations extend to forty-four crania, which when analysed give the following results as regards the proportion between the cephalic and vertical indices in the two sexes. Fourteen, viz., four males and ten females, had the vertical index less than the cephalic; seven, viz., six males and one female, had these two indices equal; and twenty-three, viz., seventeen males and six females, had the vertical index greater than the cephalic.

By combining the measures which MM. de Quatrefages and Hamy have themselves made, those contained in Dr. Barnard Davis's collection, those recorded by Prof. Flower in his Catalogue, and the forty-four specimens measured by myself, a series of about one hundred and fifty Australian crania, derived both from the extensive coast-line and the interior of that great island-continent, is before us, from which the following conclusions may be drawn as to the relations of length, breadth, and height in the two sexes.[2]

In fifty-one specimens the vertical index was less than the cephalic, and of these twenty-one were probably males and thirty females; in fifteen these two indices were equal, and of these eleven were probably males and four females; in eighty-five the vertical index was greater than the cephalic, and of these sixty-seven were probably males and eighteen females.

As the localities from which one hundred and twenty-nine of the above crania were derived are known, it is now possible to form a general conclusion as to the parts of Australia in which the crania have a tendency to possess a vertical index below the cephalic, *i.e.*, to show dolicho-platycephalic proportions.

[1] These specimens are either in the Phrenological Museum in this city, in the collection of Dr. Arthur Mitchell, or have been recently presented to the Anatomical Museum of the University. A specimen, a male, from the Milang tribe of South Australia in the Lake Alexandrina district, 50 miles south-east of Adelaide, presented by Mr. R. S. Rogers, is especially interesting. It is a characteristic dolicho-platycephalic skull, length 191 mm., height 125 mm., breadth 130 mm. The vertical index is 65, the cephalic index 68. The glabella and supra-orbital borders are massive and projecting. The face was unfortunately injured, so that the orbital and nasal indices can only be given approximately as 72 and 56, *i.e.*, microseme and platyrhine. The gnathic and palato-maxillary indices could not be obtained.

[2] Dr. Lucæ has given in his Morphologie der Rassen-Schädel measurements of six Australian crania from the Clarence River district in the northern part of New South Wales, but his measurements cannot be combined with the above, as they were made by a different method. Dr. Schaaffhausen has, however, remeasured these and the other crania in the Senckenberg Museum in Frankfurt (*Archiv für Anthropologie*, Bd. xiv., Sup. 20, 1883), in which there are now seven skulls from the Clarence River. The five males and one female all possessed a greater height than breadth, the respective measurements being H. 140, B. 126; 136, 131; 140, 128; 132, 128; 136, 122; 129, 124. One female, on the other hand, was not so high as broad, the measurements being H. 123, B. 128.

Twenty specimens were from North Australia. Of these in only two, a female from Cape York, and a male from Alexandra Land, were the vertical indices less than the cephalic, in another, a female from Port Essington, these two indices were equal, but in the remaining seventeen from Cape York, Arnhem Land, Camp in Heaven,[1] Raffles Bay, and Port Essington the vertical index exceeded the cephalic, and of these, thirteen were probably males and four females.

Three specimens were from North-west Australia. In none was the vertical index less than the cephalic; in one, a male, from the De Grey river, these indices were equal; in one from Roebuck Bay and in one from Dampier Land, both of which were probably males, the vertical index exceeded the cephalic.

Twenty-one specimens were from Queensland. In none was the vertical index less than the cephalic. In four, two males and two females, these indices were equal, and of these one was from Port Curtis, and another from Curtis Island (lat. 23°, long. 151°). In seventeen, all apparently males, the vertical index was greater than the cephalic, and these were from Moreton Bay, Rockhampton, and the interior of the colony.[2]

Twenty-six specimens were from New South Wales. Seven of these, two males and five females, had the vertical index less than the cephalic, one was from Bathurst, one from the coast near the southern part of the colony, and the rest from parts of the colony not exactly specified. In three males from Swan Hill, Port Jackson, and the Murrumbidgee these two indices were equal. In sixteen, nine males and seven females, the vertical index was greater than the cephalic; these specimens were from the Riverina, Mudgee, Macquarrie, Swan Hill, Lower Murray, Maitland, M'Leay, Port Stephen, and Sydney districts.

Nine skulls were from West Australia. One, a male, from Perth, had the vertical index less than the cephalic; two males from King George's Sound and Swan River had these indices equal; five males and one female from Eucla, Cape Leeuwin, King George's Sound, and Swan River had the vertical index greater than the cephalic.

Victoria furnished twenty-eight crania. In six, two males and four females, the vertical index was less than the cephalic, and these skulls came from Gipps Land, Western Victoria, Lake Timboon, and Port Fairy. In one, a male, from Hobsons Bay, these two indices were equal. In twenty-one specimens, fourteen males and seven females, from Port Philip, Western Port, the Murray, Port Fairy, the Upper Yarra, the neighbourhood of Melbourne, Piccaninny Creek, Gobo Island, Lake Timboon, Benalla, and the Wannon River, the vertical index exceeded the cephalic.

[1] I give this locality on the authority of MM. de Quatrefages and Hamy. I have not been able to find the name marked on any map to which I have had access.

[2] In addition to the specimens from Queensland referred to in the text, I may state that ten skulls, all with one exception, from Bowen in that colony, are in the Godeffroy Museum, Hamburg. I observe from Dr. Krause's measurements that in six males and three females, the height is greater than the breadth, and in one female only is the reverse to be noted, the breadth in that specimen being 133 mm., the height 130 mm.

South Australia proper contributed twenty-two crania. Of these, seventeen specimens had the vertical index less than the cephalic, viz., ten males and seven females; the crania came from the neighbourhood of Adelaide, Port Augusta, Lake Alexandrina, the Milang tribe, and the Coorong tribe. Two, a male and a female, had the cephalic and vertical indices equal. In three males, from Fowlers Bay, Adelaide, and Port Augusta, the vertical index was greater than the cephalic.

It would appear, therefore, that in this large and varied series only two skulls occurred, collected to the north of the latitude of the southern boundary of Queensland, viz., a female from Cape York, and a male from Alexandra Land, in which the vertical index was less than the cephalic. On the other hand, from south of that latitude, a considerable number of crania possessing this character have been obtained. Victoria, N. S. Wales, and South Australia proper, but more especially the last named, have furnished the greater number. But along the whole southern seaboard, from Perth on the west to Gipps Land on the east, and more particularly in the district near Adelaide, dolicho-platycephalic skulls have been procured. The proportion which South Australia has furnished is so large that, of the twenty-two skulls from that colony, seventeen had the vertical index less than the cephalic, and two others had these indices equal.[1]

The question therefore now arises, is this difference in the relations of the two indices so marked and so constant that the people in whom it is found are either to be regarded as a race differing from those who do not possess this character, or that it is merely sexual. As regards its relation to the two sexes, it was not limited to the one or the other. Of the series of thirty-three crania exhibiting this character, probably seventeen were males and sixteen females, and in the South Australian group of these, ten were males and seven females. It is therefore so nearly equally manifested in the two sexes, that it cannot be said to distinguish one sex more than the other. It is more difficult to pronounce definitely as to its value in the discrimination of racial differences. Its great relative frequency in the tribes of the southern seaboard points to the conclusion that, in the natives of this part of the coast-line, a genetic tendency existed to develop skulls exhibiting this character.

But it would not be safe to state that, because of this difference in the single character of the relation of the breadth to the height of the skull, those with a vertical index lower than the cephalic were therefore of a different race from those whose vertical index was higher. And this the more so when we find that the relations of breadth and height are not constant in the people of the same district. Thus, of the four

[1] Since the above was written I have read M. Cauvin's paper in the *Bull. de la Soc. d'Anth. de Paris*, March 1883, on the races of Oceania, in which he argues that, owing to diversities in the details of structure in the Australian skulls, that race is not pure but mixed. He gives a table of the cephalic, nasal, and orbital indices of fifty-two crania from different parts of the island, but he does not refer to the height index, so that I cannot utilise his table in connection with the question of dolicho-platycephalism. Some of the skulls he has measured are mesaticephalic, others brachycephalic.

skulls from Adelaide in the Barnard Davis collection, whilst three had the vertical index less than the cephalic, in the fourth the height was greater than the breadth; of the two skulls from the same burial-ground near Port Augusta, in the Museum of the College of Surgeons, one had its vertical index less, the other greater than the cephalic; of the four skulls from Port Fairy in the same Museum, three had the vertical index less, the fourth greater than the cephalic.

The strongly projecting supraciliary ridges and glabella, which have also been described as characteristic features in the dolicho-platycephalic crania, are by no means confined to them. The skulls of the Milang and Coorong tribes, markedly dolicho-platycephalic, have undoubtedly massive ridges in the supra-orbital and supra-nasal regions, but other Australian skulls, in which the height considerably exceeded the greatest breadth, possessed this character in as great, if not a greater degree. Of the skulls which I have myself examined, the Riverina, Eucla, and Wannon River crania may be again referred to as exhibiting this character in a remarkable manner. The Riverina skull is probably one of the most massive in this region in any collection of Australian skulls, and yet, as may be seen in Table III., its height exceeded its greatest breadth by 14 mm. The dolicho-platycephalic cranium is not necessarily associated with great gnathic projection, for although in the skulls of the Coorong and Lake Alexandrina tribes, and in one from New South Wales (No. 67), the gnathic index was 103 or upwards, yet in another dolicho-platycephalic cranium from New South Wales (No. 1), and in two from Gipps Land, this index was below 100. Again, in Australian crania the height of which distinctly exceeded the breadth, as in a Queensland, the Riverina and Roebuck Bay specimens, a high gnathic index was found, that of the last named skull being 108. Neither does there seem to be any definite relation between dolicho-platycephalism and the nasal index, for although the Coorong, Lake Alexandrina, and Milang skulls, all from tribes in close proximity to each other, were distinctly platyrhine, the index of the Perth skull was 50, and in one of the Gipps Land specimens only 49, although in the other it was 56. On the other hand, amongst non-dolicho-platycephalic crania, as in a Queensland, the Riverina and Benalla specimens, the platyrhine index rose to 60.

As regards such physical characters as can be determined by an examination of the external form and general appearance of the natives, there does not appear to be any very definite evidence of the co-existence of two distinct races. In corroboration of the statement of Mr. Brough Smyth already quoted (p. 44), I may also refer to a short article on the Aborigines of South Australia by Mr. J. D. Woods,[1] in which he says that the same description will apply to the natives all around the coast-line. This probable homogeneousness of race is also borne out by a general uniformity of customs, laws, and weapons. So little is known of the Roebuck Bay natives, where Dr. Martin considered important differences to exist between the coast and interior tribes, that no definite opinion of the

[1] *Trans. and Proc. of Phil. Soc. of Adelaide, South Australia*, p. 81, 1878–9.

people in this locality can be arrived at. So far as I know, only one skull from this district is in any collection, and although, as I have pointed out in this Report, it presents certain remarkable characters, yet as there is only one specimen I am not prepared to say that they are anything more than individual peculiarities.

The evidence afforded by the study of the skulls of the Australians does not therefore appear to me to sustain the view that two or more distinct races of aborigines, since the discovery of Australia by Europeans, have been or are now living side by side. In no series of crania from one locality do we find such a combination of characters so marked as to differentiate them from the natives of another locality. The fact, however, that in South Australia proper, and in other places, more especially along the southern seaboard, there is a special tendency for the crania to possess a height index distinctly below that of breadth, would perhaps justify the inference that amongst those tribes an intermixture may at some previous time have taken place with a people in whose crania the height index was normally below that of the breadth, and that in proportion to the extent of this intermixture did this modification in the cranial indices show itself.

In connection with this I may refer to the relations of length, breadth, and height in the skulls of the now extinct Tasmanians, a people who, from their geographical position, and from the fact that they had constructed and attained considerable proficiency in the use of both canoes and rafts,[1] may at an early period of their unwritten history have migrated across Bass Strait. MM. de Quatrefages and Hamy in their twenty-first Table give the measurements of five Tasmanian men and three women. In the men the mean vertical index was 71·6, in the women 68·9, whilst the cephalic index in the men was 77·7 and in the women 75·2. Prof. Flower gives the measurements of the Tasmanian crania in the Museum of the College of Surgeons, and places the cephalic index of fourteen skulls at 76·3, and the vertical index of the same number at 72·6. In both these series therefore, the vertical index is much below the cephalic. But there is this important difference between the Tasmanians and the Australians, viz., the much higher cephalic index of the former, so that in their relation of length and breadth they are mesaticephalic. It is possible that the Tasmanians may have at a remote period occupied the southern part of Australia, and have been displaced by the present Australian race, but that an intermingling of the two races may have occurred along the southern sea-board.

On the other hand New Guinea and other islands to the northward are inhabited by a dolichocephalic race, whose crania, as will be described in subsequent pages, have a vertical index distinctly above the cephalic, and as they are a seafaring people, it is not unlikely that an infiltration of Papuan blood amongst the Australians may have taken place.

[1] See Mr. Brough Smyth's account of the Aborigines of Tasmania in vol. ii. of the Aborigines of Victoria, already cited.

ADMIRALTY ISLANDERS.

Plates III., IV., V., VI. Tables VII., VIII., XVIII., XIX.

The skulls from the Admiralty Islands were the most valuable part of the craniological collection, as apparently no Europeans had landed on these islands prior to the visit of H.M.S. Challenger, and skulls of the natives were unknown in our museums. They were collected in March 1875, in villages on the coast of Wild Island, one of the small islands off the north-western end of the main island, whilst the Challenger lay at her anchorage in Nares Harbour.

An interesting account of the physical characteristics of the inhabitants of these islands has been published by H. N. Moseley, Esq., one of the naturalists to the Expedition,[1] and as it will be useful to bring his description alongside of that which I am about to give of the crania, I reproduce it here.

TABLE VII.—*Physical characteristics.*—The following measurements were taken:—

MEASUREMENTS in inches of NATIVES of the ADMIRALTY ISLANDS, taken by the late R. VON WILLEMOES SUHM, being of NATIVES of WILD ISLAND, except 6, 7, 8, 9, taken on board the ship by VON SUHM and H. N. MOSELEY.

		Height.	Breadth.	Arm Length.	Leg Length.	Foot Length.	Hand Length.	Nose Length.	Forehead Length.	Ear Length.	Breasts Length.		
WOMEN.	1. Old woman; 40 years ca.,	60	15	28	...	10	7	...	...	...	7		
	2. Young girl; 15 years ca.,	61½	15	25	33	9½	...	1⅞	...	2½	...		
	3. Older women of mean size,	60	12	25	...	9	6⅞	2	3	...	6½		
	4. Old female,	63	...	...	...	10	8	...	...	...	...		
	Mean,	61	14	26	33	9½	7½	2	3	2½	6¾		
											Mouth Length.	Penis Length.	Weight in lbs.
MEN.	1. Young man,	67	16	29	37	9½	7	2	2	2¼	2⅝	...	...
	2. Adult,	63	18	28	35	10½	7	2⅝	3	2⅞	...	...	...
	3. Adult,	63	17½	27½	34	9½	...	2	...	2½	3⅛	...	...
	4. Adult,	66	17½	28½	...	...	...	...	...	2⅝	...	...	...
	5. Oto,	67	17½	...	...	...	...	...	...	...	...	..	...
	6. Adult,	64¾	...	...	...	...	...	...	...	...	...	...	122
	7. Adult (photographed),	63	...	...	...	9¾	...	...	...	...	...	...	...
	8. Adult,	62½	17¼	27½	33½	10¼	8	1⅞	3	3	3	3	133
	9. Young man,	66¾	16	27	34	10	7½	2	3⅜	...	...	3½	126
	Mean,	64⅞	17⅐	28	34⅜	9⅝	7½	2	3	3	3	3¼	127

[1] On the Inhabitants of the Admiralty Islands, *Journ. Anthrop. Inst.*, May 1877

"Further measurements of numbers 8 and 9.—8, girth of chest with arms held up, 36; 9, girth of chest, 33. Breadth of foot just behind origin of toes 14½. Girth at umbilicus, 30. Round buttocks, 34.

"Two heights of adult men taken by me, 68 and 60¾ inches.

"The measurements of the legs were taken from the great trochanter of the femur to the sole of the foot. Those of the breadth from tip to tip of clavicles. Those of the hand from the inner margin of the palm to the tips of the middle finger. Those of the forehead from the root of the nose to the commencement of the hair. The chest girth measurements were taken with the arms upheld.

"Average specimens were selected by von W. Suhm as far as possible. The mean height of the men, as will be seen from the table, is about 5 feet 5 inches. Whilst the tallest man measured was 5 feet 8 inches, and an unusually short one only a fraction over 5 feet, the mean height of the women is 5 feet 1 inch.

"It is difficult, and possibly of little value, to compare the measurements here obtained with those given in the Anthropological part of the 'Novara' publications, vol. iii., since the methods of measurement differ widely. I have, however, by adding together the lengths there given separately for fingers, hand, forearm, and arm, and treating this as the length of the arm, obtained the ratio of the length of the body to the length of the arm in several races, and compared it with the similar ratios in the case of the Admiralty Islanders, using the averages of the measurements where available. The results are shown in the following table:—

	Measurements in Millimetres.		
	Height.	Length of Arm.	Ratio of Height to Length of Arm.
New Zealanders, men,	1757	859	2·04
Australian men,	1675	819	2·04
Australian women,	1596	770	2·07
Tahitian women,	1614	772	2·09
German men,	1680	789	2·1
German women,	1544	713	2·1
Admiralty Island men,	1646	711	2·30
Admiralty Island women,	1549	660	2·30

"Whence it appears that the Admiralty Islanders are short armed.

"The race is of average height, but the weight is, as usual with savages, below that of Europeans; 126 lbs (nine stone), as compared with 150 lbs, about the weight of an average Englishman. The natives contrasted at first glance with the Papuans of Humboldt Bay in being far thinner and lankier. I saw but one native that was at all fleshy, although such were not uncommon at Humboldt Bay. The usual colour of the natives is a black-brown, often very dark, and darker than that of the Papuans of Humboldt Bay. The young girls and young boys appear much lighter as a rule than the adults. Some one or two of the younger women were of a quite light yellowish-brown, as was also one young man who came from a distance to the ship to trade. I saw no old women who were light coloured.

"The arms and legs of the men are covered with a short, sparse, curly black hair, which appears as

if growing in separate locks,[1] exactly as in the Humboldt Bay natives. Hair is rarely present in any quantity on the back or chest, but in a few exceptionally hairy examples it was well marked.

"The hair of the head, which is worn long only by the younger adult males, formed in them a dense mop, projecting in all directions 6 to 8 inches from the head. It appeared less luxuriant in growth than that of the Papuans of Humboldt Bay. The hair is crisp, glossy, and extremely elastic, and every hair rolls itself up into a spiral of small diameter.

"In general appearance, thus, it is fine curly like that of Fijians. On comparing it with a very small sample of hair of the natives of Humboldt Bay, taken from several native combs, the Papuan hair proves to be somewhat coarser; but in other respects the two hairs are closely alike, the diameters of the spirals of the curls being the same. Some hair from a native of Api, New Hebrides, is of about the same coarseness as the Admiralty Island hair, but the curls are of much smaller diameter. The hair of the Api Islanders seems to be remarkable for the fineness of its curls. In Tongan hair the curls are of far larger diameter than those of the Papuan or Admiralty Island hair.

"The fineness of the curl of the hair in various Polynesian and Papuan races which I have seen seems to be pretty constant in each race and characteristic. It might be estimated by measuring the diameter of the circles formed by the separate spirally twisted hairs, and taking the average of several measurements. No doubt a certain curve of the hair follicles corresponds with, and produces the curl in the hairs, as in the case of the hair follicles of the negro, as discovered by Mr. Stewart;[2] but the amount of curve will be peculiar to each race. The hair of both head and body of the Admiralty Islanders is naturally black, that of the head being of a glossy black.

"A very slight trace of whiskers is present in most of the men, as a small black streak on the very upper part of the cheek, looking almost like a continuation of the hair of the crown. Regular bushy whiskers were seen only in the case of one man, who had a continuous frill round his face, formed of conjoined whiskers and beard. This man was also remarkable for the greater hairiness of his body; hence I imagine that whiskers and hair generally on the face are exceptional, and not removed by shaving. One or two men had short pointed beards without whiskers.

"Eyebrows were generally absent, very probably shaved off (the natives made signs when offered razors that they used obsidian knives for shaving). I saw eyelashes long and well-developed in some youths.

"The eyes are not in the least oblique, and open full and widely. The iris is of a dark brown. The forehead is somewhat flattened. There is usually a well-marked depression at the origin of the nose, the brow thus somewhat overhanging. The cheek bones are prominent, the face diminishing rapidly beneath them, to terminate in the straight fronted chin. The nose is usually short, with wide alæ and flattened tip. The nostrils are not patent in the adults, or only just to be seen into under the alæ.

"In the children the noses are more flattened, and the nostrils somewhat more patent. The septum

[1] This appearance is probably merely due to the tendency of the hairs evenly distributed at their bases to collect together and combine into curls, and must not be taken to imply necessarily the existence of a condensation or aggregation of hair follicles at certain spots, producing hair growing in separate locks, which condition was formerly erroneously supposed to occur on the scalps of Papuans. The body hairs form small curly locks in other races.

[2] Charles Stewart, M.R.C.S., F.L.S., Note on the Scalp of a Negro, *Micr. Journ.*, 1873, p. 54.

[Dr. T. P. Anderson Stuart confirms the statement of the curve of the hair follicles in the negro, but places the papilla very much laterally to the opening of the follicle, so that the hair grows freely up out of the scalp, and the plane of the curl is vertical to the surface of the scalp. *Journ. Anat. and Phys.*, April 1882.—W. T.]

nasi in all the adults is perforated, and the lower margin of the perforation usually dragged down by the suspension of ornaments, so that in a profile view of the face the large aperture in the septum is looked through by the observer.

"Some of the natives, as at Humboldt Bay, have most remarkable long Jewish noses. About 1 in every 15 or 20 has such a nose. I at first imagined that this form of nose was produced to some extent by long action of excessively heavy nose ornaments, but I saw one youth of only 16 or 17 with such a nose very fully developed, and I saw more than one woman with a well-marked arched nose with dependent tip, and the women appear to wear no nose ornaments. An incomplete mixture of two races may possibly exist here, but unfortunately I did not carefully observe with this view whether the natives with Jewish noses showed other points in common in which they differed from the remainder of the population. One of the most marked instances of these peculiar features was that of the head man or chief of Wild Island (Oto).

"The lips are of a light brown, very slightly pinkish. They are usually very little prominent, and are not unusually large. The chins are usually straight in front, not rounded, and not prominent, sometimes apparently receding. The jaws are wide. The lower line of the jaws is remarkably straight and horizontal. The lobes of the ears are enlarged and dragged into a long loop by the weight of suspended ornaments. The penis is usually of moderate size. I saw only one man who had a remarkably large one.

"Some few of the women were large and stout. One woman that I saw must have been 5 feet 6 inches in height, but such women were exceptional.

"Drawings of the heads of three natives are given, enlarged from photographs, in Pl. xxiii. figs. 1, 2, 3.

"Variability. The occurrence of Jewish noses in a certain number of the Admiralty Islanders has already been described. As another instance of variability, I may state that I saw one boy on Wild Island who, though in other respects just like the rest, had his hair quite straight. Light-coloured skins were rare, but I saw one man and two women whose skins were of a light yellow colour."

General characters of the crania.—The collection of crania from the Admiralty Islands consisted of eleven skulls, a calvaria, and a face. Only one skull had the lower jaw attached, but there was in addition a loose lower jaw, which could not definitely be associated with any of the crania. The individual crania are distinguished in this description by the letters A to N inclusive.[1]

Several of the crania had the appearance of having been exposed to the weather, as the outer table was peeling off in thin flakes, and the bones were greenish and discoloured. The majority of the crania were smeared with a red pigment, usually without any pattern, but in two specimens A and M, a red band had been drawn around each orbit, and vertical lines on the frontal bone.

The orbits in the skull D were each filled with a black hardened mass, in the centre of which was a valve of a bivalve shell to represent the eye. A similar black material had been used to fill up the hollow at the base of the skull, between the foramen magnum

[1] By the permission of the Lords Commissioners of H.M. Treasury I exhibited and described these crania at the International Medical Congress in London, August, 1881. An abstract of my communication was published in the *Transactions of the Congress*, vol. i. p. 146, Anatomical section, and in the *Journ. Anat. and Phys.*, vol. xvi. p. 135.

and the posterior nares. The nasal fossæ were also occupied by it, and it had been employed to model an artificial nose of a low aquiline form.[1] In seven of the crania a hole had been knocked through the squamous part of each temporal bone, and in two of the specimens a piece of cane had been passed through the holes for the purpose of suspending the skulls. Prof. Moseley states that it is a common practice to stick in the thatch of the houses the skulls of animals and of man. He states that—

"At D'Entrecasteaux Island one having an ornament in the nose was suspended to the front of a house over the doorway, by means of a stick thrust through holes in the two squamous parts of the temporal bone. This skull the owner could not be induced to part with, but usually they were sold pretty freely, and they were in considerable abundance about the houses, but often much shattered. A dozen only were purchased."[2]

In each skull, with one exception, one or both zygomatic arches had been broken, sometimes so much that the greatest zygomatic diameter could not be measured. Two of the crania were tied together by a piece of split cane passed through the sphenomaxillary fissure in the wall of the orbit. The cranial characters were those of persons who had reached adult life, and in two specimens were inclining to a more advanced age. Some of the skulls were undoubtedly males, others females. But it was difficult to decide to which of the two sexes others of the crania had belonged. I have, however, arranged them in two groups, and am disposed to regard seven as males and five as females. The skulls are not large or heavy, and they do not give one the impression of belonging to a people either of big stature or great muscular development, which is in accordance with Prof. Moseley's measurements of height and weight (p. 52).

Norma verticalis.—The crania showed many features in common. They were elongated antero-posteriorly. They were neither flattened nor ridge-shaped at the vertex, but had a gentle curve across the vertex from one parietal eminence to the other. Below the parietal eminences, the sides of the skull approached the vertical, although in the majority of the crania the transverse diameter was a little greater near the squamous suture than at the parietal eminences. In two specimens the stephanic and asterionic diameters were equal, in three the stephanic exceeded the asterionic, in seven the asterionic exceeded the stephanic. Only two specimens were phænozygous, and these but slightly.

Norma lateralis.—Some of the crania rested behind on the conceptacula, others on the mastoid processes and only one on the occipital condyles. With two exceptions the

[1] I may refer to my paper on Two Masks and a Skull from Islands near New Guinea, in *Journ. Anat. and Phys.*, vol. xiv. July 1880, for an account of a number of methods of decorating and preserving the crania or heads of the dead in use amongst the Aborigines of the Malayo-Polynesian Archipelago.

[2] In a recent letter to me Prof. Moseley states :—"from what is now known, it is most probable that the crania obtained from the roofs of the houses were those of persons who were eaten by Admiralty Islanders; their skulls being set up as trophies of the feast, and, according to Miklucho-Maclay, to be used as a kind of chronological record. The skulls collected were probably those of inhabitants of the main island of the Admiralty group caught alive, or bought or killed for food. But if, as is barely possible, the Admiralty Islanders have any intercourse occasionally with neighbouring groups the victims may have come from thence."

glabella and supraciliary ridges were feeble, so much so indeed that the difference between the glabello-occipital and ophryo-occipital diameters in no instance exceeded 2 mm., and usually was not more than 1 mm. The forehead was not retreating. The profile outline of the crania through the upper frontal, parietal, and occipital regions, formed a continuous curve. In all, the most projecting part of the occiput was in the occipital squama above the occipital protuberance. Some of the crania showed a slight flattening in the hinder parietal region; this flattened part was not however vertical, but inclined downwards and backwards to form a curve with the superior occipital squama, so that it did not resemble the flattening produced in the parieto-occipital region in skulls subjected to artificial compression during infancy. In the crania generally the cerebellar fossæ in the occipital bone had no great bulging, and in two specimens this part of the bone was almost flat on its inferior aspect. In K the occipital region was unsymmetrical, for the left side of the bone projected further back than the right. In all except one specimen the frontal longitudinal arc exceeded the occipital. In all except one skull the parietal arc exceeded the frontal, and in all the parietal was greater than the occipital.

The nasal bones were neither large nor very prominent; they varied in length from 15 to 26 mm. and in greatest breadth from 5 to 10 mm. They curved downwards and forwards, so that the osseous bridge of the nose was shallow and concave; but owing to the feeble glabella the naso-frontal suture was not deeply depressed. The interzygomatic exceeded the stephanic, asterionic, and intermalar diameters in all the skulls where the zygomata were so uninjured as to permit that diameter to be measured, but the interzygomatic diameter with one exception (B) was less than the greatest breadth in the parieto-squamous region. In several instances the intermalar breadth was greater than either the stephanic or asterionic. The mean interorbital breadth was 21·7 mm., the maximum in two instances being 26 mm., the minimum in one specimen 18 mm.

In all the specimens except H and K the teeth were fully erupted, but in the majority of the crania the teeth had dropped out of the alveoli, obviously before the skulls were collected. The teeth which remained were either bicuspids or molars, and the grinding surfaces of the crowns were not as a rule much worn down. The incisors were not in place in any one of the skulls, although their sockets were unabsorbed. None of the teeth showed any evidence of decay. G was the only skull in which a canine tooth was present; it was worn almost to a stump, and the sockets of the molars were in process of absorption. In H the sockets of the upper canines and wisdom teeth were absorbed.[1]

The cranial sutures were as a rule simple in their denticulations, and this simplicity

[1] None of the crania exhibited that very remarkable magnitude of the incisor teeth which Miklucho-Maclay has described in some natives of the Admiralty Islands and of Hermit Island. The upper incisors in these persons projected downwards and forwards so as to appear between the lips. In one case, which he measured, the crown of an incisor tooth was 22 mm. long, 19 broad, and 11 mm. thick. The women showed this peculiarity less frequently than the men. See Verhandl. der Berlin Gesellschaft für Anthrop., 16 Dec. 1876, in *Zeitschr. für Ethnol.*, Bd. viii., 1876.

was especially marked in the upper half or so of the coronal suture, and in the more anterior part of the sagittal. In only two specimens, C and G, were the sutures beginning to disappear from senile changes, and in C the molars showed more than in any other skull the effects of use on the crowns. In all, the basi-cranial synchondrosis was ossified. No skull was metopic. In each of the two lower jaws the coronoid process was feeble and the sigmoid notch was shallow. In one the chin was feeble, in the other it was more massive, rounded at its lower border and projected forwards.

In E and I a broad tongue-like process of the squamous temporal was interposed between the left ali-sphenoid and the antero-inferior angle of the parietal. An epipteric bone was situated on the right side of E, between the ali-sphenoid and parietal, and two large epipterics were placed in K between the left ali-sphenoid and parietal. On the right side of D a single epipteric was situated in the spheno-parieto-frontal suture, but it did not entirely cut off the ali-sphenoid from the parietal. H had a similar bone in the spheno-parietal suture. In the other skulls the pterion was normal, though in G the spheno-parietal articulation was very small. One or more Wormian bones were present in the lambdoidal suture in A, B, D, E, F, H, and K; in the last of which they were large and infringed considerably on the area of the parietal bones. In H a small triquetral bone was in the sphenoido-frontal suture.

The male skull K exhibited a rare and interesting irregularity in the ossification of the cranial bones; for in it the right parietal was completely but unequally separated into an upper and a lower division by an antero-posterior suture, situated in the position of the temporal ridge, and extending from the coronal to the lambdoidal suture. This suture was much denticulated, and had an os triquetrum in its posterior third. The vertical diameter of the upper division of this parietal bone, midway between the coronal and the lambdoidal sutures, was 81 millimetres, and of the lower division only 42 mm. A large Wormian bone in the lambdoidal suture infringed upon the posterior part of the upper division. The left temporal ridge of the same skull was well marked, and in proximity both to its anterior and posterior ends was a faint appearance of a suture as if the left parietal also had been separated into an upper and a lower division at an earlier period of life. In the course of my anatomical experience, during which many hundreds of human crania have passed through my hands, I have only seen one other specimen in which a similar division of the parietal bone occurred, and this was in the right parietal of a fœtus, between the eighth and ninth month, dissected by Dr. Ramsay H. Traquair, who described it in the Natural History Review.[1]

Cases of division of the parietal have, however, from time to time been recorded by other anatomists. Winslow[2] and von Doeveren[3] had each in their possession in the last century, and von Sömmerring[4] described in the earlier part of the present century, a

[1] 1863, vol. iii. p. 132.

[2] See Tarin's Osteographie, Paris, 1753.

[3] Specimen Observ. Acad. Groningæ, 1765, quoted by Wenzel Gruber.

[4] Tiedemann and Treviranus's *Zeitschrift für Physiologie*, s. I., Tafel I., 1826.

skull in which one or both parietals had been divided by an antero-posterior suture into an upper and a lower part. In Winslow's and von Sömmerring's cases the crania were adults, in von Doeveren's the skull was that of a child. Wenzel Gruber described[1] the skull of a male fœtus in which, along with other malformations, the left parietal was divided into an upper and a lower portion; also the cranium of an adult in which the posterior and lower part of the left parietal was a separate piece: in 1870 he described and figured[2] a right parietal in a youth as divided into two parts by a suture extending diagonally from the anterior end of the sagittal suture to about the middle of the lambdoidal: in 1876 he described and figured[3] an adult male skull, in which the postero-inferior angle of the parietal, with the part of the bone for some distance above it, was separated from the rest by a suture extending from the squamous to the lambdoidal suture: in 1879 he described[4] three other adult crania; in one the posterior and lower part of the left parietal was separate from the rest of the bone by a suture extending from the squamous to near the apex of the lambdoidal suture, in a second each parietal was divided by a suture extending forwards from the lambdoidal through the lower part of the bone, in the third the right parietal was divided by a suture passing from the lower end of the coronal to about the middle of the lambdoidal suture. Lucæ[5] and Welcker[6] have each described a skull with the parietal divided by an antero-posterior fissure into an upper and a lower part. Hyrtl has also figured[7] the skull of an adult and those of three fœtuses in which a similar division of the bone was met with.[8]

In all the specimens the os planum of the ethmoid was small, and wherever it was uninjured, so that its shape could be determined, it was quadrilateral in form, although in Z its anterior border was elongated forwards and not vertical. In D, F, H, and L, remains of the maxillo-premaxillary suture were visible on the surface of the hard palate. Only in C had the hard palate any great depth, being 16 mm. in that skull opposite the second molar tooth. In five crania a suture extended from the infraorbital foramen through the lower border of the orbit into the floor of the orbit and the infraorbital canal.

In E the nasal bones had apparently not been developed. The nasal spine of the frontal bone appeared on the surface of the osseous bridge of the nose, immediately below the glabella, and descended between the ascending processes of the superior maxillæ. Below the free end of this spine the ascending processes of the superior maxillæ articulated with each other mesially for about $\frac{2}{10}$ths of an inch. In the same skull a distinct

[1] Abhandl. a. d. mensch. u. vergl. Anatomie, 1852; also *Mém. de l'Acad. Imp. de St. Petersbourg*, ser. 7, t. ii., 1859.

[2] *Virchow's Archiv*, Bd. l., p. 113, 1870.

[3] *Virchow's Archiv*, Bd. lxvi., p. 468, 1876.

[4] Beobachtungen aus der menschlichen und vergleichenden Anatomie, Heft ii. p. 12, e.s. pl. iii., Berlin 1879.

[5] Zur Architectur d. Menschenschädels, 1857.

[6] Untersuch. ü. Wachsthum u. Bau des mensch. Schädels, 1862.

[7] Die doppelten Schläfelinien der Menschen-schädel, *Denkschr. d. k. Akad. d. Wiss. Wien.* 1871.

[8] At the meeting of the Anatomical Section of the International Medical Congress, at which I exhibited and described the Admiralty Island crania, I understood Prof. von Kölliker to say that a similar skull was in the Museum of the University of Würzburg.

shallow concave articular facet (third condyle) for the odontoid process of the axis was situated on the anterior border of the foramen magnum.[1] The lateral condyles of the occipital bone did not, however, exhibit a degree of flattening such as is sometimes seen associated with the presence of a third occipital condyle ; they were indeed more convex than in others of the crania in which no third condyle was present.

In all the crania the nasal spine of the superior maxillæ was distinctly marked, and the floor of the anterior entrance into the nose formed almost a right angle with the lateral boundary, and was not rounded off, except in L, in which there was marked prognathism of the upper jaw, and the alveoli of the upper incisors projected forward.

The mean cephalic index of twelve crania was 70. That of the seven probable males

TABLE VIII.—ADMIRALTY ISLANDERS, CHAL.

	Collection,	A.	C.	D.	E.	F.	K.	N.	B.	G.	H.	I.	L.	M.
	Age,	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.
	Sex,	M.	M.	M. ?	M.	M. ?	M.	M.	F.	F.	F. ?	F.	F.	Face.
	Cubic capacity,	1528	1292	1252	1353	1410	1430	...	1068	1257	1220	1187	1140	...
	Glabello-occipital length,	185	184	176	186	186	185	184	170	185	178	179	177	...
	Ophryo-occipital ,,	184	183	174	186	185	185	182	169	184	177	180	176	...
	Basi-bregmatic height,	144	131	133	138	138	132	132	124	120	127	130	122	...
	Vertical Index,	*77*	*71*	*75*	*74*	*74*	*71*	*72*	*72*	*64*	*71*	*72*	*69*	...
	Minimum frontal diameter,	90	88	90	97	99	95	100	86	92	86	88	89	91
	Stephanic, ,, ,,	112	105	102	103	110	112	114	100	104	98	94	99	...
	Asterionic, ,, ,,	116	106	98	108	110	112	108	91	118	108	102	102	...
	Greatest parietal breadth,	130*s*	132*s*	129*s*	129*p*	133*s*	130*s*	134*s*	120*s*	125*s*	126*s*	124*p*	121*s*	...
	Cephalic Index,	*70*	*72*	*73*	*69*	*71*	*70*	*73*	*70*	*67·5*	*70*	*69*	*68*	...
	Horizontal circumference,	520	515	490	515	517	517	516	480	510	493	490	485	...
	Frontal longitudinal arc,	140	126	115	136	139	120	127	120	120	117	124	114	116
	Parietal ,, ,,	150	148	137	148	130	150	134	124	133	128	134	130	...
	Occipital ,, ,,	114	...	114	110	127	121	115	110	115	108	118	108	...
	Total ,, ,,	404	...	366	394	396	391	376	354	368	353	376	352	..
	Vertical transverse arc,	320	295	288	301	311	312	...	270	276	283	285	275	...
	Length of foramen magnum,	31	...	28	30	33	33	29	28	33	30	31	34	...
	Basi-nasal length,	100	96	99	95	102	96		96	99	99	100	90	...
	Basi-alveolar length,	98	99	102	102	106	99		92	106	100	98	103	...
	Gnathic Index,	*98*	*103*	*103*	*107*	*103*	*103*		*96*	*107*	*101*	*98*	*114*	...
	Interzygomatic breadth,	...	126	127	128	...	...		128	122	...	119	...	...
	Intermalar ,,	112·5	108	109	112	110	116		110	104	108	110	101	113
	Ophryo-alveolar length,	89	84	77	76	75	91		77	88	84	87	80	92
	Naso-alveolar ,,	68	65	62	56	58	72		60	68	66	64	61	70
	Facial Index,	...	*66*	*61*	*59*	...	...		*60*	*72*	...	*73*	...	...
	Nasal height,	51	48	...	45	46	54		51	56	57	47	49	52
	Nasal width,	24	26	...	25	25	22		22	25	22	21	25	28
	Nasal Index,	*47*	*54*	...	*55*	*54*	*41*		*41*	*44*	*38*	*45*	*51*	*54*
	Orbital width,	38	37	39	37	37	39		35	37	38	39	33	39
	Orbital height,	36	29	33	31	30	38		28	32	30	34	32	32
	Orbital Index,	*95*	*78*	*84*	*83*	*81*	*97*		*80*	*86*	*79*	*87*	*97*	*82*
	Palato-maxillary length,	53	59	54	57	56	55	Calvaria only.	51	58	51	54	59	...
	Palato-maxillary breadth,	60	62	64	63	61	65		59	62	62	56	63	...
	Palato-maxillary Index,	*113*	*105*	*118*	*110*	*109*	*118*		*115*	*107*	*121*	*104*	*107*	...
Lower Jaw.	Symphysial height,	...	...	...	...	...	...		...	...	27	...	...	29
	Coronoid ,,	...	...	...	...	..	...		...	...	62	...	...	50
	Condyloid ,,	...	...	...	...	...	...		...	...	64	...	...	54
	Gonio-symphysial length,	...	...	...	...	...	...		...	...	93	...	...	86
	Inter-gonial width,	...	...	...	...	...	...		...	...	80	...	...	79
	Breadth of ascending ramus,	...	...	...	...	...	...		...	...	...	...	..	...

[1] The changes which lead to the formation of a third condyle in this region have been discussed by the late Prof. Halbertsma, De derde Gewrichtsknobbel, 1865, abstracted by Dr. Barnard Davis in an article on Dutch Anthropology in the *Anthropological Review*, vol. iii. 1865, and by Dr. Wm. Allen in *Journ. Anat. and Phys.*, vol. xv. p. 60, 1881.

was 71; of the five probable females 69. The maximum cephalic index in two of the crania (males) was 73; the minimum in one (female) 67·5. The skulls were therefore markedly dolichocephalic, for not a single specimen had a mesaticephalic, and still less a brachycephalic index.

The mean vertical index of twelve crania was 72; that of the males was 73, of the females 70. The mean of the whole series and of the males was metriocephalic, that of the females tapeinocephalic. The maximum vertical index in one (male) was 77, the minimum in one (female) was 64. The mean height in relation to the length was somewhat greater than the mean breadth; a result which was due to the greater vertical diameter of the male crania. For the mean basi-bregmatic height of seven males was 135 mm.; the maximum being 144, the minimum 131 mm. The mean corresponding height of five females was only 125 mm.; the maximum being 130, the minimum 125 mm. In the males the height exceeded the greatest breadth in five cases, but in two the breadth very slightly exceeded the height. In the females the height was slightly in excess of the breadth in four cases, whilst the breadth somewhat exceeded the height in one.

Owing to the broken zygomatic processes in several of the crania, the bizygomatic diameter could only be taken in six specimens, and consequently in these only could the proportion of the breadth to the ophryo-alveolar length be measured, and a facial index be obtained. The mean facial index was 65; that of three males 62, and three females 68. The maximum facial index in one (female) was 73, the maximum in one (male) 59.

The mean gnathic index of eleven crania was 103, and this general average was alike in the two sexes. The maximum gnathic index in one skull (female) was 114; the minimum in one (female) 96. If we take 103 as marking the lowest term of prognathism, then four of the crania reached this index, and only three exceeded it; whilst three skulls ranged from 98 to 101, and one was below 98. Hence it may be said that one was orthognathous, three were mesognathous, four were at the lowest term of prognathism, and only three were decidedly prognathic. The mean average of the series was on the line between mesognathism and prognathism. The basi-nasal length was greater than the basi-alveolar in three crania, *i.e.*, in those in which the gnathic index was below 100.

The mean nasal index of eleven crania was 48; that of six males was 51, that of five females was 44. The maximum nasal index in one skull (male) was 55; the minimum in one skull (female) was 38. Four of the skulls, and these all males, were platyrhine, one, a female, was mesorhine, and the remaining six were leptorhine. The mean average was on the line between the leptorhine and mesorhine.

The mean orbital index of twelve crania was 86; and this index was alike in the two sexes. The maximum orbital index was 97 in both a male and a female, the minimum was 78 (male). Both in the males and females the mean orbital index was mesoseme, although in two males and one female it rose to megaseme, and in four males and two females it sunk to microseme.

The mean palato-maxillary index of eleven crania was 112, and this index was practically the same in the two sexes. The maximum palato-maxillary index was 121 (female), the minimum was 104, also a female. The palate exhibited, therefore, as a rule, no great disproportion between its breadth and its length, it was mesuranic, and like the crania of the Fiji Islanders measured by Prof. Flower, was in its form rather intermediate between the parabolic and the hypsiloid.

As seven of the crania had holes in the squamous temporals, and one other was slightly imperfect near the foramen magnum, the cubic capacities could only be estimated approximately. The mean capacity of eleven crania was 1285 cubic centimetres.[1] That of six males was 1377·5, that of five females was 1154. The maximum cranial capacity in one (male) was 1528; the minimum in one (female) was 1068. Only one skull classified as female exceeded in capacity the lowest of the skulls classified as males. This classification was based upon the general characters of the skulls, and not upon their capacities. If we take 1350 cubic centimetres as the lowest limit of mesocephalism, then four of the eleven skulls exceeded it, and these were probably male skulls. Of these four, one was megacephalic, and three were mesocephalic. The two remaining male skulls were microcephalic. The male crania, therefore, may be regarded as in the average mesocephalic in capacity, the female as microcephalic; and the general average capacity of the series was microcephalic. The ratio between the sexes is as 100 to 84, which is a low average for the female.[2]

To summarise the conclusions now arrived at from the analysis of the table of measurements, I may state that the crania of the Admiralty Islanders are distinctly dolichocephalic; on the line between tapeinocephalic and metriocephalic; cryptozygous; on the line between mesognathism and prognathism; on the line between the leptor-

[1] These figures of the cubic capacity differ somewhat from those printed in the abstract in the *Trans. Inter. Med. Congr.*, for the measurements I had made at that time were with sand, whereas those now given have been taken with shot in the manner described in the introduction to this Report.

[2] In the collection was another skull, marked in Prof. Moseley's handwriting, "Admiralty Islander?" In a letter to me, Mr. Moseley states that he found the skull unlabelled in one of the cupboards of the laboratory on the Challenger, but could get no one to identify it with certainty. From various circumstances he was disposed to think that it came from the Admiralty Islands, and wrote therefore upon it, but with a query. Owing to the uncertainty as to where it came from, and from the differences between it and the skulls which undoubtedly came from one of those islands, I have not included it in the description. The length of the cranium was 178 mm., its greatest breadth was 142 mm.; its basi-bregmatic height 135 mm. It was not only absolutely shorter than the greater number of the Admiralty Island skulls described above, but it was very much wider than even the widest of them, so that its cephalic index was 80. Its vertical index was 76, which places it considerably above the mean of the other crania. The gnathic index was 100; the palato-maxillary index was 126, the palate being distinguished by its great width in relation to its length. This skull had a very different appearance from those above described. Its great width gave it the rounded brachycephalic form. Its interzygomatic breadth was 140 mm., which gave a breadth to the face much in excess of the widest face amongst the above crania. No pigment had been smeared over the bones. If they were natives of the Admiralty Islands I have no hesitation in saying that this skull did not belong to the same race, so that if it were collected on Wild Island, it was a representative of a different people from those whose crania are described in the text. As they were the rule and it the exception, it was, granting the accuracy of its place of collection, probably an imported specimen, not unlikely a brachycephalic brown Polynesian.

hine and mesorhine as regards the nasal index; mesoseme as regards the orbital index, mesuranic as to the length and breadth of the palato-maxillary arch; microcephalic for the females, but mesocephalic for the males.

SANDWICH ISLANDERS.

Plates V., VI. Tables IX., X., XI., XII., XVIII., XIX.

These crania were from two different islands in the group, viz., Hawaii and Oahu. Four skulls were presented by W. L. Green, Esq., the foreign minister to the King of the Sandwich Islands, who took them from a cave on Waimea Plains, Hawaii, near the Hill of Holohaloku. Mr. Green, in a letter to Sir Wyville Thomson, states that "this cave is an ancient burial place, and that it contains the remains of dozens of skeletons. Some of the bodies are mummified, and implements are also found. Some years ago a drunken white set fire to the place, and there are bushels of charred bones there. Some of these skulls sent shew marks of the fire. I have sent some eighty skulls to Dr. J. Barnard Davis, who has them all gauged and catalogued."

The other crania, thirty-three in number, some of which were accompanied by other bones of the skeleton, were contained in boxes labelled "Kanakas from Oahu, Sandwich Islands, 15 miles from Honolulu." These skulls are referred to by Prof. H. N. Moseley, in his Notes by a Naturalist on the Challenger,[1] in the following paragraphs:—

"Whilst the ship was at Honolulu, I visited the north-east side of the island and collected at Waimanalo, on the estate of Mr. John Cumming, a series of native skulls from a deserted burial-place. The burials are amongst dunes of calcareous sand, and the bones are exposed by the shifting of the sands by the wind. The burials are often on the sides of the gullies between the dunes. They have probably been made in this locality because of the ease with which the sand is excavated. Similar burials occur at various spots around the coast of Oahu, and I know of no place where so abundant material is ready at hand for the study of the skeletal peculiarities of a savage race, by the examination of long series of crania and skeletons, as here. Other burials occur in caves inland, where the bodies are found in a dried mummy-like condition.

"All the bodies at Waimanalo were buried in a doubled-up posture. One which was exhumed with care *in situ*, was buried with the knees bent up to the chest and the head bent forwards, and was placed resting horizontally on the back. Chips and fragments of basalt were found around all the graves, but no implements of stone."

Hawaii.—As the four crania from Waimea, Hawaii, possessed a strong family resemblance to each other, I shall in the first instance describe their characters. They were all adults, and apparently males.

Norma verticalis.—Broad-headed, parietal tubera prominent. They were scarcely ridged in the sagittal region; the sides of the cranium were almost vertical below the

[1] London, 1879.

tubera. They were slightly phænozygous. The stephanic diameter was in all in excess of the asterionic, and the greatest breadth was in two cases in the parietal, in the others in the squamous regions.

Norma lateralis.—The skulls rested behind on the mastoids or on the occipital condyles. The glabella and supraciliary ridges were not especially prominent, except in one specimen; the frontal profile did not recede greatly from the glabella. The skulls were somewhat flattened behind, in the region of the obelion and occipital squama, and there was a rapid downward slope from the obelion to the inion, and with a comparatively slight projection of the occipital squama behind the inion, characters which are so marked in brachycephalic skulls. It is possible that the flattening had been assisted by artificial pressure applied during infancy. In three of the specimens there was a slight obliquity in the occipital region, as if the pressure had not been symmetrical. The frontal longitudinal arc was always in excess of the parietal, and the parietal, except in one specimen, was in excess of the occipital. The cerebellar part of the occipital bone was not horizontal, but sloped upwards and backwards to the protuberance and superior curved line; the conceptacula cerebelli had no especial bulging. The foramen magnum was always longer than wide: the maximum length was 35 mm., and the width in the same skull was 29 mm.

The bridge of the nose was slightly concavo-convex and not very prominent. The nasal bones varied in length from 22 to 25 mm. and in width from 8 to 12 mm. The nasal spine of the superior maxillæ was distinct but not strong. The junction of the side wall with the floor of the anterior nares was slightly rounded. In the skull with strong supraciliary ridges the external angular processes were prominent, and the temporal ridges were strong. The interzygomatic breadth considerably exceeded the intermalar, stephanic, and asterionic, and the intermalar breadth in each case was somewhat greater than the stephanic and considerably more than the asterionic; but the interzygomatic was less than the greatest transverse diameter. The mean interorbital breadth was 25·5, the maximum 28, the minimum 23. In A the length of the face was from the ophryon to the chin 135 mm., from the fronto-nasal suture to the chin 112 mm. In B the corresponding dimensions were respectively 126 and 108 mm.

The teeth in all were fully erupted, except in one, in which the wisdoms were not present; the teeth were not much worn, and there was no decay. The sutures were sometimes simple, at others more denticulated and not obliterated from age. No Wormian bones were in the lambdoidal suture. One skull had a triquetral bone in the left pterion and two in the right. In A the squamous temporal articulated with the frontal in the right pterion. The os planum was normal except on the left side of B, in which a small triquetral intervened between its upper half and the lachrymal. No skull was metopic, and there was no division of the malar bone. In one the maxillo-premaxillary suture was faintly indicated on the palate. In C an elongated ivory exostosis projected from the posterior wall of each auditory meatus outwards to the orifice. In D a large

paramastoid depended from the right jugal process of the occipital. In A a small third condylar surface was at the front of the foramen magnum, but without marked flattening of the occipital condyles. Both in A and D a suture extended through the infraorbital foramen into the floor of the orbit.

A and B had lower jaws, not very massive and with no great development of chin.

TABLE IX.—WAIMEA PLAINS, HAWAII, SANDWICH ISLANDS, CHAL.

Brachycephali.

		A.	B.	C.	D.
	Collection,	Ad.	23	Ad.	Ad.
	Age,	M.	M.	M.	M.
	Sex,	1338	1635	1420	1328
	Cubic capacity,	169	178	176	173
	Glabello-occipital length,	167	174	172	170
	Ophryo-occipital „	142	143	142	138
	Basi-bregmatic height,	*84*	*80*	*81*	*80*
	Vertical Index,	90	102	98	95
	Minimum frontal diameter,	112	118	123	110
	Stephanic, „ „	101	113	108	104
	Asterionic, „ „	142*p*	148*s*	146*s*	148*p*
	Greatest breadth,	*84*	*83*	*83*	*85*
	Cephalic Index,	492	523	510	510
	Horizontal circumference,	122	131	132	126
	Frontal longitudinal arc,	119	130	122	118
	Parietal „ „	109	119	106	121
	Occipital „ „	350	380	360	365
	Total „ „	310	323	325	312
	Vertical transverse arc,	30	35	33	31
	Length of foramen magnum,	107	102	108	102
	Basi-nasal length,	106	100	100	96
	Basi-alveolar length,	*99*	*99*	*92*	*94*
	Gnathic Index,	136	144	143	130
	Interzygomatic breadth,	122	122	125	120
	Intermalar „	85	85	92	90
	Ophryo-alveolar length,	64	64	71	64
	Naso-alveolar „	*62*	*59*	*64*	*69*
	Facial Index,	48	50	56	51
	Nasal height,	23	26	26	21
	Nasal width,	*48*	*52*	*46*	*41*
	Nasal Index,	37	38	36	36
	Orbital width,	34	37	36	36
	Orbital height,	*92*	*97*	*100*	*100*
	Orbital Index,	57	54	56	54
	Palato-maxillary length,	62	64	67	63
	Palato-maxillary breadth,	*109*	*118*	*119*	*116*
	Palato-maxillary Index,				
Lower Jaw.	Symphysial height,	30	24	...	...
	Coronoid „	69	67	...	...
	Condyloid „	71	57	...	...
	Gonio-symphysial length,	91	93	...	...
	Intergonial width,	95	104	...	...
	Breadth of ascending ramus,	39	41	...	...

The sigmoid notch in A was very shallow, in B a little deeper. The gonio-symphysial length in both was less than the intergonial width.

The mean cephalic index was 84, and the range of variation from 83 to 85 was only 2. The skulls were therefore all decidedly brachycephalic. The mean vertical index was 81, and the range of variation from 80 to 84, was only 4. The mean basi-bregmatic height was below the mean breadth, and in only one specimen were these dimensions equal. The skulls were decidedly akrocephalic. The mean gnathic index was 96, and the range from 92 to 99 was 7. Two were orthognathic and two mesognathic. The mean facial index was 74·5 and the range from 71 to 77 was 6. The mean nasal index was 47, and the range from 41 to 52 was 11. Two were mesorhine, two leptorhine. The mean orbital index was 97, and the range from 92 to 100 was 8. They were all megaseme. The mean palato-maxillary index was 115, and the range from 109 to 119 was 10. The average cubic capacity was 1430 c.c.; the maximum 1635 c.c., the minimum 1328 c.c.; the skulls therefore were in the mean mesocephalic.

These skulls from Waimea were in their average proportions brachycephalic, akrocephalic, phænozygous, either orthognathic or mesognathic, leptorhine or mesorhine, megaseme, on the verge of brachyuranic and mesocephalic.

Oahu.—The skulls and accompanying bones of the skeleton from Oahu were with few exceptions bleached perfectly white from exposure, those not white were light brown, and had without doubt been concealed in the sand.

Two distinct types of skulls were found in the series; the one definitely brachycephalic, the other as distinctly dolichocephalic, whilst a third set were intermediate in the form and proportions of the cranium.

The brachycephalic crania were seven in number, and are distinguished in the accompanying table by the letters I, K, S, V, Aa., Ac., Ah. They were all adults, with the exception of Ah. Judging from the dentition, Ah. was a child of 8 or 9, probably a boy; the milk molars and the first true molar were in place, but the second true molar and canines had not erupted. Four of the adults were evidently males, two females, and one of the latter was accompanied by the pelvis and other bones of the skeleton. I compared these adult skulls with the series of four brachycephali from a cave on Waimea Plains above described, and I found that the general configuration of the cranium was so much alike in both series, that no special description of these specimens from Oahu seems to be necessary, though it should be stated that the skulls from Oahu were cryptozygous. In each skull the frontal arc and the parietal arc exceeded the occipital. In four skulls the frontal and parietal arcs were almost or quite equal to each other; in two the frontal arc considerably exceeded the parietal; in one the parietal exceeded the frontal. In each skull the stephanic diameter was greater than the asterionic. In the males the greatest parietal diameter was nearer the parietal eminence than the

squamous suture, in the females and child the reverse was the case. The interzygomatic diameter was considerably below the interparietal. The mean interorbital diameter was 23·5, the maximum 26, the minimum 21. The bridge of the nose was slightly concavo-convex, the nasal bones varied in length from 21 to 25, and in greatest breadth from

TABLE X.—OAHU, SANDWICH ISLANDS, CHAL.

Brachycephali.

Collection,	K.	S.	V.	Aa.	I*.	Ac.	Ah.
Age,	Ad.	Ad.	Ad.	21	Ad.	Ad.	Æt. 8
Sex,	M.	M.	M.	M.	F.	F.	M?
Cubic capacity,	1398	1675	1535	1430	1345	1495	1508
Glabello-occipital length,	176	184	182	174	175	178	164
Ophryo-occipital „	174	180	179	174	174	176	165
Basi-bregmatic height,	140	144	142	141	136	140	132
Vertical Index,	*79*	*78*	*78*	*81*	*78*	*78*	*80*
Minimum frontal diameter,	96	98	97	92	94	88	92
Stephanic, „ „	121	126	115	112	112	115	117
Asterionic, „ „	102	116	110	105	105	102	114
Greatest breadth,	146*p*	155*p*	148*p*	150*p*	146*s*	146*s*	152*s*
Cephalic Index,	*83*	*84*	*81*	*86*	*83*	*82*	*92*
Horizontal circumference,	506	541	523	504	512	506	499
Frontal longitudinal arc,	126	140	128	128	125	127	124
Parietal „ „	136	107	124	128	125	126	117
Occipital „ „	112	...	118	105	120	118	109
Total „ „	374	...	370	361	370	371	350
Vertical transverse arc,	313	338	325	333	310	318	328
Length of foramen magnum,	29	...	36	35	32	32	34
Basi-nasal length,	100	108	110	...	100	104	89
Basi-alveolar length,	97	...	110	...	102	104	88
Gnathic Index,	*97*	...	*100*	...	*102*	*100*	*99*
Interzygomatic breadth,	129	142	138	...	126	129	119
Intermalar „	115	124	119	...	110	110	108
Ophryo-alveolar length,	88	...	89	...	85	86	73
Naso-alveolar „	69	...	66	...	63	63	57
Facial Index,	*68*	...	*64*	...	*67*	*67*	*61*
Nasal height,	48	...	51	...	47	50	42
Nasal width,	22	...	23	...	27	24	20
Nasal Index,	*46*	...	*45*	...	*57*	*48*	*47*
Orbital width,	37	38	39	...	36	36	34
Orbital height,	35	35	31	...	33	37	33
Orbital Index,	*95*	*92*	*79·5*	...	*92*	*103*	*97*
Palato-maxillary length,	53	...	58	...	55	54	45
Palato-maxillary breadth,	...	...	65	...	66	...	59
Palato-maxillary Index,	...	...	*112*	...	*124*	...	*131*
Lower Jaw. Symphysial height,	26	...	...	...	28	...	...
Lower Jaw. Coronoid „	64	...	...	...	60	...	...
Lower Jaw. Condyloid „	62	...	...	...	53	...	...
Lower Jaw. Gonio-symphysial length,	86	...	...	...	88	...	...
Lower Jaw. Intergonial width,	89	...	...	...	86	...	...
Lower Jaw. Breadth of ascending ramus,	33	...	...	...	35	...	...

* With pelvis.

6 to 10 mm. S and V had each a small exostosis in the roof of the right auditory meatus. Ah. had a triquetral bone in each pterion and V one in the left pterion. On the right side of I was a large spheno-pterygoid foramen, due to the development of a plate of bone between the external pterygoid process and the spine of the sphenoid; on the left side the foramen was not quite complete. No skull was metopic. In K, V, and Ac., a suture extended from the infraorbital foramen into the floor of the orbit and infraorbital canal.

In the two lower jaws the sigmoid notch was shallow, and the coronoid process was on the whole feeble. The chin was fairly marked. The gonio-symphysial and intergonial diameters were nearly equal. The child's skull being excluded, the mean cephalic index was 83. The adults ranged in the cephalic index from 81 to 86, but the child had an index of 92. The mean vertical index was 79, which places them in the akrocephalic series, though not so high as the Waimea skulls. The somewhat smaller average of the vertical index was probably due to two of the adult crania from Oahu being females. The mean gnathic index was 100, somewhat higher, therefore, than those from Waimea, so that they were with one exception mesognathous. Owing to the nasal index of the female skull I being as high as 57, the mean was raised to 49, so that the average was mesorhine. The mean orbital index of the adults was 92, and they were all megaseme except V, which was microseme. In only two of the adults could the palate be measured, and the mean palato-maxillary index of these specimens was 118. The mean cubic capacity of the set of seven skulls was 1484 c.c.; that of four adult males was 1509·5 c.c., of two adult females 1420 c.c.; the males were megacephalic, the females mesocephalic. This group of Sandwich Islanders was in their mean proportions brachycephalic, akrocephalic, cryptozygous, mesognathic, mesorhine, megaseme, brachyuranic, and mesocephalic.

Fifteen of the crania from Oahu had the cephalic index below 75 and were all distinctly dolichocephalic. They were all adults. Eight were presumably males and seven females, and of the latter three were accompanied by the pelvis and other bones of the skeleton.

Norma verticalis.—Sagittal line was ridged, the parietal eminences were prominent, and the roof of the skull had a ridge-shaped and "ill filled" appearance. The cranium was both more elongated and narrower than in the brachycephali. The greatest parietal breadth, both in the males and females, was sometimes near the parietal eminence, at others near the squamous suture. As distinguished from the brachycephalic skulls, in only one instance did the greatest parietal diameter exceed 140 mm., viz., in Y, in which it was 142 mm., whilst in the two groups of brachycephali in only one instance was it as small as 142 mm., and in three specimens it reached 150 mm. or upwards. On the other hand, in the dolichocephali the glabello-occipital diameter fell in only one instance below 180 mm. (viz. in A to 175 mm.), whilst in three specimens it exceeded 190 mm. In

the brachycephali the corresponding diameter was in one case as low as 164 mm., and it exceeded in only two cases 180 mm. The stephanic diameter was usually greater than the asterionic, although sometimes the asterionic was wider in the same skull; but the average stephanic was markedly less than in the brachycephali. Below the parietal eminences the skulls were wall-sided. With three exceptions they were phænozygous.

Norma lateralis.—These skulls showed a continuous gentle curve from the glabella to the inion, and had not an abrupt descent from the obelion to the inion which characterised the brachycephalic crania above described. There was no definite sign of flattening from artificial pressure. The glabella and supraciliary ridges were not particularly prominent, even in the male skulls, and the frontal profile receded in them from the glabella. The cerebellar region of the occiput, although not horizontal, yet did not slope so much upwards to the inion as in the brachycephali. Many of the crania when placed on a plane surface rested behind on the conceptacula cerebelli, but some rested on the occipital condyles. The frontal longitudinal arc exceeded in eight specimens the parietal, but in six specimens was below it. The parietal arc was in excess of the occipital in all except three specimens.

The osseous bridge of the nose was concave or concavo-convex, and sometimes so curved that the nostrils would doubtless have been directed downwards and forwards. The nasal bones varied in length from 20 to 25 mm., and in greatest breadth from 5 to 13 mm. The nasal spine of the superior maxillæ was not strongly marked. The sides of the nasal opening were rounded at their junction with the floor of the nose. The interzygomatic and intermalar diameters were greater than either the stephanic or asterionic. The interzygomatic diameter approached more closely the greatest breadth in the parieto-squamous region than in the brachycephali from the same locality, and in three instances somewhat exceeded it. The mean interorbital width was 24 mm.; the maximum 28 mm., the minimum 20 mm. In some of the skulls the teeth had been lost, and some others were much worn, but there was no decay. In several of the crania obliteration of the sutures from age was in progress. In four specimens Wormian bones were in the lambdoidal suture. The os planum of the ethmoid was normal. No skull was metopic, and there was no subdivision of the malar bone. Faint indications were seen on the hard palate of the maxillo-premaxillary suture in two specimens. In one skull a deep-seated exostosis projected from the anterior wall of the external meatus. In B a spheno-pterygoid foramen was present on each side, and in W a projection from the sphenoidal spine approached the external pterygoid plate of the sphenoid. D had a paramastoid process on the left side. In several of these crania a suture extended from the infraorbital foramen into the floor of the orbit and infraorbital canal.

In the lower jaws the sigmoid notches had no great depth; the chin was not massive. The intergonial width was in three cases equal to the gonio-symphysial length, though in two it surpassed and in two was somewhat less than the latter.

In this series of skulls the mean cephalic index for each sex was 73, the minimum both a male and a female 71, and the maximum both males and females 74. They are therefore distinctly dolichocephalic. The mean vertical index was 75, which is considerably below that of both the groups of brachycephali in Tables IX. and X., and exists both in the male and female series. They are therefore metriocephalic. The mean basi-bregmatic height of the seven female skulls was 136 mm.; the maximum height was 140 mm., and the minimum was 132 mm. The mean corresponding height of six male skulls was 143 mm.; the maximum was 150 mm., and the minimum was 138. These measurements are confirmatory of the observations made by Ecker, Cleland, and

TABLE XI.—OAHU, SANDWICH ISLANDS, CHAL.

Dolichocephali.

	Collection,	C.	D.	G.	Q.	R.	U.	Y.	Ad.	A.*	B.*	L.*	W.	X.	Ae.	Ag.
	Age,	Aged.	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Aged.	Aged.	Ad.
	Sex,	M.	M.	M.	M.?	M.	M.?	M.	M.	F.	F.	F.	F.	F.	F.	F.
	Cubic capacity,	...	1465	1345	...	1332	1488	...	...	1218	1470	1362	1280	1425	1227	1358
	Glabello-occipital length,	188	184	186	184	184	194	192	188	175	193	186	182	186	180	180
	Ophryo-occipital ,,	187	182	180	182	181	192	189	185	175	193	182	180	182	178	179
	Basi-bregmatic height,	150	146	144	...	142	140	...	138	136	138	136	135	140	132	133
	Vertical Index,	*80*	*78*	*77*	...	*77*	*72*	...	*73*	*77*	*71*	*73*	*74*	*74*	*73*	*74*
	Minimum frontal diameter,	100	94	102	87	90	99	99	96	90	98	96	93	95	88	92
	Stephanic, ,, ,,	108	104	110	108	108	114	116	118	102	109	110	112	112	95	110
	Asterionic, ,, ,,	110	104	109	104	108	108	110	100	100	97	106	104	108	108	104
	Greatest breadth,	138*p*	134*p*	138*s*	136*p*	132*s*	138*p*	142*s*	138*s*	128*p*	138*p*	138*s*	136*s*	137*p*	130*p*	134*s*
	Cephalic Index,	*73*	*73*	*74*	*74*	*72*	*71*	*74*	*73*	*73*	*71*	*74*	*74*	*74*	*72*	*74*
	Horizontal circumference,	538	510	515	503	508	541	538	524	485	530	522	511	515	494	508
	Frontal longitudinal arc,	134	123	123	131	135	128	127	130	127	136	124	128	130	120	114
	Parietal, ,, ,,	130	...	123	124	127	127	142	129	132	131	135	127	110	128	120
	Occipital, ,, ,,	116	...	112	118	119	136	...	...	104	118	118	113	133	122	130
	Total ,, ,,	380	375	358	373	381	391	...	...	363	385	377	368	373	370	364
	Vertical transverse arc,	310	314	298	293	307	312	315	311	300	310	302	298	308	295	302
	Length of foramen magnum,	34	36	31	...	35	33	...	...	33	35	34	33	37	30	36
	Basi-nasal length,	118	107	116	...	104	109	...	108	96	108	104	102	108	104	99
	Basi-alveolar length,	110	110	116	...	...	104	...	109	92	108	108	101	97	108	100
	Gnathic Index,	*93*	*103*	*100*	...	...	*95*	...	*101*	*96*	*100*	*104*	*99*	*90*	*104*	*101*
	Interzygomatic breadth,	132	141	142	126	134	137	136	...	118	...	135	132	137	126	..
	Intermalar ,,	116	121	124	112	116	120	124	120	108	115	119	116	116	114	115
	Ophryo-alveolar length,	87	84	85	82	...	84	91	91	78	89	88	83	88	90	87
	Naso-alveolar ,,	65	63	63	61	...	64	66	70	55	63	63	65	65	68	65
	Facial Index,	*66*	*59*	*60*	*63*	...	*61*	*67*	...	*66*	...	*65*	*62*	*64*	*71*	...
	Nasal height,	56	60	53	50	53	48	51	52	41	51	49	51	52	50	51
	Nasal width,	26	27	27	23	...	26	27	24	23	27	27	26	26	24	25
	Nasal Index,	*46*	*45*	*51*	*46*	...	*54*	*53*	*46*	*56*	*53*	*55*	*51*	*50*	*48*	*49*
	Orbital width,	40	40	37	35	36	38	39	39	35	39	38	36	39	37	38
	Orbital height,	36	34	34	31	30	30	35	36	31	34	32	31	34	32	36
	Orbital Index,	*90*	*85*	*92*	*89*	*83*	*79*	*90*	*92*	*89*	*87*	*84*	*86*	*87*	*86*	*95*
	Palato-maxillary length,	54	59	58	54	...	58	56	57	53	56	56	51	48	56	51
	Palato-maxillary breadth,	61	59	63	63	...	65	61	59	53	64	65	58	61	60	62
	Palato-maxillary Index,	*113*	*100*	*109*	*117*	...	*112*	*109*	*103*	*100*	*114*	*116*	*114*	*127*	*107*	*121*
Lower Jaw.	Symphysial height,	24	28	33	...	25	...	...	...	25	31	30	...	...	...	...
	Coronoid ,,	64	65	72	...	62	...	...	...	60	67	67	...	...	...	...
	Condyloid ,,	...	63	68	...	60	...	...	...	55	62	62	...	...	...	...
	Gonio-symphysial length,	84	86	98	...	84	...	...	...	86	92	95	...	...	...	...
	Intergonial width,	88	93	98	...	84	...	...	...	86	88	93	...	...	...	...
	Breadth of ascending ramus,	36	38	43	...	36	...	...	...	36	43	43	...	...	...	...

* With Pelvis.

other craniologists, that the female skull has a less vertical diameter than the male. In the male crania the height and breadth in one skull were equal, in all the others the height of each skull exceeded its breadth by from 2 to 12 mm. In the female crania six were either equal or almost equal in height and breadth, and in only one specimen did the height surpass the breadth by 8 mm. The mean gnathic index was 98·6, *i.e.*, mesognathous; four of the skulls were orthognathous, six mesognathous, and two, both of which were females, decidedly prognathous. The mean nasal index was 50, *i.e.*, mesorhine, but four specimens were leptorhine, and three were platyrhine. The mean orbital index was 87·6, *i.e.*, mesoseme; only two specimens were microseme, whilst five were megaseme. The mean palato-maxillary index was 111, and it is remarkable that in two of the specimens the length and breadth were equal, whilst in a third the breadth exceeded the length by only 2 mm. The mean capacity was 1361 c.c.; that of four males 1407·5 c.c.; that of seven females 1334 c.c. The general average, as well as that of the males, was mesocephalic, the females microcephalic. The average is much below that of the brachycephali measured in Tables IX. and X., which though in part, perhaps, to be accounted for by the smaller proportion of male skulls, is presumably also in part due to racial differences.

This group of Sandwich Islanders was, in its average proportions, dolichocephalic, metriocephalic, as a rule phænozygous, mesognathic, mesorhine, mesoseme, mesuranic, and mesocephalic.

From the great differences in the absolute and relative length and breadth of these dolichocephalic crania as compared with the brachycephalic skulls described on p. 65, as well as from the difference in their vertical index, I can have no doubt that the dolichocephalic skulls belonged to a different race from those that had the brachycephalic form and proportions.

Eleven skulls from Oahu ranged in their cephalic index from 75 to 79 inclusive, and were mesaticephalic, therefore, in their proportions. They were all adults; six were presumably males and five females. Although I have grouped them in a table separate from the purely brachycephalic and dolichocephalic skulls from the same locality, I do not wish it to be supposed that I regard them as belonging to a distinct race. The line, indeed, which separates mesaticephalic skulls, on the one hand from dolichocephali, and on the other from brachycephali, is quite arbitrary, so that crania with mesaticephalic proportions pass almost insensibly either into brachycephalic or dolichocephalic according to their place either at the upper or lower term of the series. Such skulls as E, F, N, and T (Table XII.), had a cephalic index so little above 74·9, which it is customary to assume to be the highest term of the dolichocephalic series, and were so closely allied in shape to the dolichocephalic skulls (Table XI.), that there can, I think, be no doubt they were of the same race. If they had therefore been included with them in Table XI., they would have slightly raised the cephalic index of the dolichocephalic series.

On the other hand, O, P, and M, with a cephalic index of either 78 or 79, not only approached in dimensions the lowest term of the brachycephalic series, but corresponded with those skulls in the form of the parieto-occipital region, and ought perhaps to have been associated with that series (Table X.) The four skulls which have a cephalic index

TABLE XII.—OAHU, SANDWICH ISLANDS.

Mesaticephali.

		E.	H.	N.	O.	P.	T.	F.	M.	Z.	Ab.	Af.
	Collection,	E.	H.	N.	O.	P.	T.	F.	M.	Z.	Ab.	Af.
	Age,	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Aged.	Ad.	Ad.	Ad.	Ad.
	Sex,	M.	M.	M.	M.	M.	M.?	F.	F.	F.	F.	F.
	Cubic capacity,	1418	1478	1364	1330	1476	1495	1412	1226	...	...	1450
	Glabello-occipital length,	181	179	188	180	182	189	182	172	182	183	186
	Ophryo-occipital ,,	179	175	184	176	179	186	181	172	182	181	185
	Basi-bregmatic height,	142	138	134	140	135	139	137	132	128	...	130
	Vertical Index,	*78*	*77*	*71*	*78*	*74*	*73*	*75*	*77*	*70*	...	*70*
	Minimum frontal diameter,	98	90	94	90	95	92	96	91	95	93	87
	Stephanic, ,, ,,	114	106	108	109	116	114	109	107	112	116	106
	Asterionic, ,, ,,	104	104	109	107	115	108	108	102	109	108	107
	Greatest breadth,	138*p*	138*s*	142*p*	142*s*	144*s*	142*p*	137*s*	134*p*	141*s*	141*p*	143*p*
	Cephalic Index,	*76*	*77*	*75*	*79*	*79*	*75*	*75*	*78*	*77*	*77*	*77*
	Horizontal circumference,	507	509	522	512	528	530	521	490	520	514	520
	Frontal longitudinal arc,	130	133	123	127	130	130	130	126	130	130	126
	Parietal ,, ,,	120	139	131	126	122	129	127	124	144	125	132
	Occipital ,, ,,	120	101	120	115	121	119	111	110	104	115	122
	Total ,, ,,	370	373	374	368	373	378	368	360	378	370	380
	Vertical transverse arc,	310	312	304	304	308	307	313	296	317	303	312
	Length of foramen magnum,	34	31	34	30	35	35	35	33	30	...	32
	Basi-nasal length,	106	106	107	108	102	106	108	98	105	...	104
	Basi-alveolar length,	102	108	111	100	...	100	...	96	107	...	...
	Gnathic Index,	*96*	*102*	*104*	*93*	...	*94*	...	*98*	*102*	...	...
	Interzygomatic breadth,	133	128	...	131	134	130	134	124	...	132	123
	Intermalar ,,	122	112	118	119	119	114	114	106	108	116	110
	Ophryo-alveolar length,	94	84	86	...	84	90	...	83	85	86	...
	Naso-alveolar ,,	70	61	65	...	61	69	...	62	65	65	...
	Facial Index,	*71*	*66*	...	...	*63*	*69*	...	*67*	...	*65*	...
	Nasal height,	52	47	50	55	47	52	55	47	50	48	47
	Nasal width,	24	25	24	27	25	26	26	23	25	27	25
	Nasal Index,	*46*	*53*	*48*	*49*	*53*	*50*	*47*	*49*	*50*	*56*	*53*
	Orbital width,	39	36	39	38	37	37	40	34	38	37	35
	Orbital height,	34	34	36	36	33	32	37	32	34	33	33
	Orbital Index,	*87*	*94*	*92*	*95*	*89*	*86*	*92*	*94*	*89*	*89*	*94*
	Palato-maxillary length,	58	56	58	...	54	56	...	53	57	54	...
	Palato-maxillary breadth,	64	...	63	...	64	64	...	55	59	63	...
	Palato-maxillary Index,	*110*	...	*109*	...	*118*	*114*	...	*104*	*103*	*117*	...
Lower Jaw.	Symphysial height,	29	...	...	...	...	...	...	29	...	...	...
Lower Jaw.	Coronoid ,,	75	...	...	...	...	...	...	57	...	...	...
Lower Jaw.	Condyloid ,,	73	...	...	...	..	...	62	56	...	...	...
Lower Jaw.	Gonio-symphysial length,	89	...	...	...	...	...	88	83	...	...	...
Lower Jaw.	Intergonial width,	96	...	...	...	...	...	94	80	...	...	...
Lower Jaw.	Breadth of ascending ramus,	37	..	...	...	...	...	41	32	...	...	...

of 77 are more difficult to arrange, but on the whole I am inclined to think that they approach more closely in shape to the dolichocephali than to the brachycephali.

For the most part these skulls rested either on the mastoids or occipital condyles, but four touched the table behind with the lower part of the cerebellar fossæ. In each specimen the frontal arc was longer than the occipital. In one the parietal and occipital arcs were equal, in the others the parietal exceeded the occipital. In four skulls the parietal exceeded the frontal. The stephanic diameter exceeded the asterionic except in two specimens, in each of which the asterionic was 1 mm. the greater. In all, the interzygomatic diameter was less than the greatest breadth in the parieto-squamous region. The basi-nasal length was in three cases less than the basi-alveolar. No skull was metopic.

As regards variations in individual skulls, Af. has an epipteric bone in the left pterion, and in the right pterion the squamous temporal articulated directly with the frontal. In three specimens one or at most two small Wormian bones were in the lambdoidal suture. H showed some want of symmetry in the occipito-parietal region, the left half of the occiput projecting behind the right; the cranial sutures were unossified, except the lower third of the left coronal, which was obliterated. In several of the skulls a suture extended from the infraorbital foramen into the floor of the orbit and infraorbital canal.

The vertical index of these mesaticephalic crania was 74 c.c.; in two specimens this index was equal to the cephalic, and in one slightly above it, but in all the other skulls the cephalic index exceeded the vertical. The lowest basi-bregmatic diameter in the female series was 128 mm., the highest 137 mm.; whilst in the male series the lowest corresponding diameter was 134 mm., and the highest 142 mm. The mean height of the female skulls was 132 mm., that of the males 138 mm. One of the skulls was prognathous, three orthognathous, three mesognathous, but the differences in the gnathic index did not correspond in any definite way with differences in the cephalic index, for the prognathous skull N, with a cephalic index 75, had a gnathic index 104, whilst the orthognathous skull T, with the same cephalic index, had a gnathic index of only 94. The nasal and orbital indices also showed a great range of variation, but there was no definite relation between these variations and that of the cephalic index. The mean internal capacity of the nine crania which it was possible to measure was 1405 c.c., *i.e.*, mesocephalic; the mean of six males was 1427 c.c., that of three females 1363 c.c. The mean of each sex was also mesocephalic.

CHATHAM ISLANDERS (MORIORI).

Plate VII. Tables XIII., XVIII., XIX.

Four crania, viz.: three adults and one child were collected. They were presented by the Colonial Museum of New Zealand, and formed a part of the large collection of crania from these islands obtained in 1872 by Mr. Travers. I have examined, along with these crania, three other specimens, also collected by Mr. Travers, which were presented some years ago to the Anatomical Museum of the University of Edinburgh, by Dr. Hector, a skull recently presented by Mr. A. H. Williams, and one from Au nui (great cloud), Wharekauri, on the north side of Chatham Island, formerly belonging to Dr. Handyside, and now in the University Museum. The crania were probably those of six men, two women, and a child, aged about six years.

Norma verticalis.—Most of the skulls had no marked antero-posterior elongation. The parietal tubera were prominent, and gave the appearance of breadth in the parietal region. There was a tendency in some of the skulls to a ridge-like elevation in the sagittal line. The cranial vault was flattened from that line outwards to the tubera, but with not much slope. The sides of the skull were almost vertical below the tubera. All the crania were phænozygous, except that of the child. As a rule the greatest width of the skull was at or near the parietal eminences. In four specimens the stephanic diameter exceeded slightly the asterionic; in four the asterionic was somewhat greater than the stephanic; in one they were equal.

Norma lateralis.—The adults all rested behind on the tips of the mastoid processes, except one, which rested on the occipital crest; but the child's skull touched the cerebellar occipital fossæ. The male crania were massive and heavy, with strong temporal ridges, and marked duplicity of these ridges was observed in the skulls. Owing to the especial prominence of the temporal ridges in the male skulls, these crania had a definite line of demarcation between the upper and lower halves of the parietal bone, so that in the norma occipitalis the skulls had the pentagonal form so well represented by Hyrtl in a Chatham Island skull.[1] One of the male skulls weighed with the lower jaw, 2 lbs. 7 oz. avoir., another 2 lbs. 6¼ oz. The glabella and supraciliary ridges, more especially in one specimen, were projecting, and the frontal bone sloped from them upwards and backwards; the backward slope of the forehead was very marked in several of the males. In two specimens the ophryo-occipital length was 5 mm. less than the glabello-occipital. From a little in front of the obelion the vault sloped downwards and backwards to the occipital point, but there was no evidence of artificial flattening. The occipital squama projected beyond the protuberance, but only very slightly in three specimens. The

[1] Die doppelten Schläfelinien, &c., *Denkschr. d. k. Akad. d. Wiss. Wien*, 1871.

frontal longitudinal arc in each adult male and in one female was greater than either the parietal or occipital; the parietal exceeded the occipital and the occipital the parietal in an almost equal number of crania. In the child the occipital arc was greater than the parietal, and the parietal than the frontal.

The bridge of the nose was fairly well defined and concave upwards and forwards, though in some it was slightly convex at the tip. The nasal bones ranged in length from 21 to 31 mm. and in greatest width from 6 to 15 mm. The nasal spine of the superior maxillæ was distinct, as a rule not very prominent, but in one specimen of considerable size. The junction of the side wall with the floor of the anterior nares was slightly rounded. Three of the crania had the external orbital process prominent, with flattening of the frontal immediately above the process.

In all the adults both the interzygomatic and intermalar diameters exceeded the stephanic and asterionic, and except in one case, where they were equal, the interzygomatic diameter was less than the greatest breadth in the parieto-squamous region. The mean interorbital diameter was 23 mm.; the maximum 26 mm., the minimum 19 mm.

The teeth in all the adults were fully erupted, though many of the sockets were empty. In the aged skulls the teeth were much worn down, but there was no decay. The dentition of the child was that of about six years.

In five specimens the sutures were in course of senile obliteration. When visible they showed no special simplicity in their denticulation. The child's skull had Wormian bones in the pterion on each side, and also in the lambdoidal suture. One adult had one in the right pterion; another one in the left pterion. A male had a large interparietal bone, and in the suture between it and the left parietal were three small Wormian bones. In none did the temporal articulate with the frontal, although the intervening alisphenoid was sometimes very narrow. No cranium was metopic. The os planum was broken in several crania, but had evidently been relatively small, though it retained its quadrilateral form. In the child and in two adults remains of the maxillo-premaxillary suture were seen on the hard palate. There was no subdivision of the malar. In one the left meatus auditorius was almost obliterated in its deep part by an exostosis, but the right was normal. In another a small exostosis projected from the roof of the deep part of the left meatus, but the right was normal. In two males the palate had a depth of 1·7 inch opposite the 2nd molar; in the others its depth was not so great. In one female there was an almost complete pterygo-sphenoid foramen; in a male a well-marked third condyle was on the basion, and in the child a right paramastoid process was present. In three of the crania a distinct suture extended from the infraorbital foramen into the floor of the orbit and infraorbital canal. In one adult male there was a pair of rudimentary paramastoid processes.

Four of the adults had the lower jaw, and in each specimen the sigmoid notch was shallow. In three males the jaw was massive with a strong chin, and in two of these

the ascending ramus was high. In the other, a female, the bone was not so strong, and the ascending ramus was much shorter.

The mean cephalic index of the eight adults was 75·2; the range of variation from the maximum 80 (male), to the minimum 72 (male), was 8. The crania were therefore, on the average, just within the mesaticephalic group, although three of the skulls were below 75. The mean vertical index was 73, and the range of variation from the minimum 70 (male)

TABLE XIII.—CHATHAM ISLANDERS (MORIORI).

	Collection,	Chal. A.	Chal. B.	E.U.A.M. A.	E.U.A.M. B.	Whare-kauri.	E.U.A.M. D.	Chal. C.	E.U.A.M. C.	Chal. D.
	Age,	Ad.	Aged.	Ad.	Aged.	Ad.	Ad.	Ad.	Ad.	6th
	Sex,	M.	M.	M.	M.	M.	M.	F.	F.	Year.
	Cubic capacity,	1458	1444	1380	1306	1488	1492	1185	1342	1492
	Glabello-occipital length,	192	190	191	190	191	185	177	184	183
	Ophryo-occipital „	190	188	188	185	186	180	177	182	184
	Basi-bregmatic height,	144	135	134	133	142	142	129	134	123
	Vertical Index,	*75*	*71*	*70*	*70*	*76*	*77*	*73*	*73*	*67*
	Minimum frontal diameter,	104	104	95	92	102	96	92	88	88
	Stephanic, „	116	110	102	107	114	116	101	102	107
	Asterionic, „	114*p*	111*p*	110*s*	110	110	108	101	108	104
	Greatest breadth,	146	138	144	136*p*	146*s*	148*p*	132*p*	137*p*	139*p*
	Cephalic Index,	*76*	*73*	*75*	*72*	*77*	*80*	*75*	*74*	*76*
	Horizontal circumference,	548	532	538	520	542	525	495	508	508
	Frontal longitudinal arc,	140	131	133	130	132	135	117	129	118
	Parietal „ „	119	124	123	124	122	253	129	122	120
	Occipital „ „	123	113	132	124	126		106	116	137
	Total „ „	382	368	388	378	380	388	352	367	375
	Vertical transverse arc,	320	301	310	286	315	316	281	290	38
	Length of foramen magnum	34	34	28	32	34	32	30	34	...
	Basi-nasal length,	113	108	103	110	111	104	100	101	89
	Basi-alveolar length,	106	100	103	104	104	102	100	98	80
	Gnathic Index,	*94*	*92*	*100*	*94·5*	*94*	*98*	*100*	*99*	*90*
	Interzygomatic breadth,	144	138	139	130	144	138	132	126	106
	Intermalar „	128	126	120	119	122	130	116	116	94
	Ophryo-alveolar length,	95	94	91	84	102	95	81	86	81
	Naso-alveolar „	76	71	71	63	77	67	61	67	60
	Facial Index,	*66*	*68*	*65*	*65*	*71*	...	*61*	*68*	*76*
	Nasal height,	58	56	60	51	57	51	46	53	44
	Nasal width,	28	25	25	25	26	25	25	25	20
	Nasal Index,	*48*	*44*	*42*	*49*	*46*	*49*	*54*	*47*	*45*
	Orbital width,	40	38	39	40	38	40	38	38	31
	Orbital height,	35	36	37	33	35	32	31	33	33
	Orbital Index,	*87·5*	*95*	*95*	*82·5*	*92*	*80*	*82*	*87*	*106*
	Palato-maxillary length,	58	56	54	54	58	55	53	56	42
	Palato-maxillary breadth,	66	64	65	61	65	64	59	60	57
	Palato-maxillary Index,	*114*	*114*	*120*	*113*	*112*	*116*	*111*	*107*	*136*
Lower Jaw.	Symphysial height,	32	...	...	...	36	30	29	...	23
	Coronoid „	80	...	...	...	84	66	61	...	50
	Condyloid „	69	...	...	...	73	58	61	...	45
	Gonio-symphysial length,	107	...	...	...	102	99	94	..	77
	Intergonial width,	103	...	...	...	100	...	90	...	74
	Breadth of ascending ramus,	41	...	...	...	40	41	43	..	32

to the maximum 77 (male) was 7. In each skull the height was less than the greatest breadth, and the altitudinal index was less than the cephalic index. The crania were metriocephalic.

The mean gnathic index was 96, and the range of variation from the minimum 92 (male) to the maximum 100 (male and female) was 8. The crania on the average were orthognathic, though three specimens were mesognathic. The mean facial index was 66, and the range of variation from 61, the lowest (a female), to 70·8 the highest (a male), was 10. The mean nasal index was 47, and the range of variation from 42 (male), the minimum, to 54, the maximum (female), was 12. On the average they were leptorhine, only two specimens exceeding the highest term of that series. The mean orbital index was 88, and the range from the lowest, 80 (male), to the highest, 95 (male), was as much as 15. The average was mesoseme, but individuals were either micro-, meso-, or megaseme. The mean palato-maxillary index was 113, and the range from 107, the minimum, to 120, the maximum, was as much as 13; the average was mesuranic. The great width of the palato-alveolar region of the child, as compared with the length, was due to the imperfect molar dentition, as only the first pair of true molars were in place.

The mean internal capacity of the adults was 1387 c.c., the mean of six males was 1428 c.c., of two females 1263·5 c.c., both the females were microcephalic. The general of the two sexes, and of the males was mesocephalic; three males were megacephalic and one microcephalic. It is remarkable that the child, of probably the sixth year, should have had a capacity of 1492 c.c.

The Chatham Island skulls were, therefore, on the mean mesaticephalic, metriocephalic, orthognathic, phænozygous, leptorhine, mesoseme, mesuranic and mesocephalic.

NEW ZEALANDERS (MAORI).

Plate VII. Tables XIV., XV., XVIII., XIX.

Three of the Maori skulls collected by the Challenger were presented by the Colonial Museum, Wellington. One of these was marked Waikato tribe, "the modern Maori," North Island; another was labelled East Cape tribe, North Island (Keu, or red haired); the third was labelled Hawea tribe, or Moa Hunter, West Coast, Jackson Bay, South Island. A fourth specimen was presented by Mr. Travers, of Wellington, but the tribal name was not given. Along with the above I have examined a series of seventeen skulls in the Anatomical Museum of the University of Edinburgh. Seven of these specimens were presented by Dr. J. Batty Tuke, who collected them in 1861, in the district of Cook's Straits; six of these crania were obtained on Kapiti, or Entrance Island, which lies on the north side of the western approach to Cook's Strait;[1] one was taken from an old Maori

[1] As the skulls from Kapiti Island are a very interesting series I transcribe from the Museum Catalogue the following notes by their donor, Dr. J. Batty Tuke, who procured them "whilst on a coasting voyage in the schooner

cooking place, the site of a fight which occurred about 30 years ago near Wanganui, north of Cook's Straits. Three specimens were from Otago; two, presented by Mr. W. Riddell, being from Chastlands Mistake, and one found in an oven at Oipopo. One was found in the Marlborough district of the Middle Island, and was presented by Dr. Philip. One presented by Mr. Lambert, was from Whangarii, to the north of Auckland. Three were from the neighbourhood of Auckland, whilst the localities of the remaining two were not known.

Nine of the twenty-one crania were adults and presumably males, nine were adults and presumably females, two were children about 8 and 10, and one was apparently a girl about 16.

Norma verticalis.—In both the males and females the crania were not uniform in appearance in each sex, for some were obviously longer and narrower than others, and did not dip so abruptly in the parieto-occipital region, so that their proportions were dolichocephalic, others were wider in the parietal region and mesaticephalic. In the males the sagittal line was slightly ridged, the parietal eminences as a rule were prominent, and the cranial vault sloped, and was flattened from the ridge to the eminences. The sides of the skull were almost vertical below the parietal tubera. All the skulls, with one exception, were phænozygous. The stephanic and asterionic diameters were equal in one specimen; in four the stephanic exceeded the asterionic; in four the asterionic exceeded the stephanic. In the females the sagittal line, except in three specimens, was not so ridge-like as in the males, and the slope from that line outwards to the tubera was less. All the skulls were phænozygous. The stephanic and asterionic diameters were equal in one specimen; in three the stephanic exceeded the asterionic; in five the asterionic was greater than the stephanic.

Norma lateralis.—Of the male skulls four rested behind on the mastoids; two on the occipital condyles; three on the conceptacula cerebelli. Of the females, three rested on the mastoids; three on the condyles; one on the conceptacula. The male crania were not so massive as those of the Moriori, for the heaviest male skull did not exceed 1 lb. 15 oz. avoir., and the next in weight was 1 lb. 12¾ oz. The inion, glabella, and supraciliary ridges were prominent. The forehead was more retreating in the males than in the females, and in the skulls with a relatively high cephalic index the descent from

"Tyne" during October 1861. We were driven by stress of weather under the lee of this island, which was at that time uninhabited except by two white men in charge of a small cattle Station. Two of the skulls (the females?) were found with their skeletons buried under ledges of rock; the others in a cave the descent to which was by a narrow shaft, and which was filled with human bones the amount of which it was quite impossible to compute. I sunk to my waist in them, and should have gone further if not supported, the lower strata being quite disorganised. This cave was the burying place of a hapu or family of the Ngatirankawa Tribe, living at Waikanai and Otaki on the mainland about eight miles distant. All such burying places are strictly held "tapu," or sacred, so that it is beyond suspicion that any of these could possibly be European skulls. Had there been natives on the island it would have been impossible to have secured these specimens. As it was, great difficulty was experienced from the superstition of the English sailors of the schooner. I have been given to understand by competent authorities that no white man had ever been in that cave before."

the obelion into the occipital region was steeper than in the more elongated crania. The occipital squama projected behind the inion, but in some specimens the projection was very slight. In the males the frontal longitudinal arc was in one case equal to the occipital, but in all the other specimens exceeded it. In six cases the frontal exceeded the parietal, in three the parietal arc was the longer. In five the parietal was greater than the occipital. In the females the frontal longitudinal arc was greater than the occipital in all the specimens except one; in two cases the frontal equalled, in four exceeded, and in one was less than the parietal. The parietal arc exceeded the occipital in four specimens, and in two was less than it.

The bridge of the nose was concave upwards and forwards, sometimes with a deep curve, in others slightly convex, near the tip. The nasal bones ranged in length from 20 to 34 mm., and in greatest width from 6 to 11 mm. The skull (Kapiti C) in which the nasal was 34 mm. by 11 mm., was that in which the interorbital diameter was 29 mm. The nasal spine of the superior maxillæ was distinct, though not as a rule very prominent. The anterior nares in some skulls were markedly wider than in others. Many of the crania were flattened in the frontal region immediately above the external orbital process, and this process was therefore prominent. In both males and females the interzygomatic and intermalar diameters exceeded the stephanic and asterionic in the same skull. The relations of the interzygomatic and greatest diameter in the parieto-squamous region were variable; in four cases the interzygomatic exceeded the interparietal, in six it was less, and in one it was equal. The interorbital diameter ranged from 21 to 29 mm.

In five skulls the upper wisdom teeth were either not erupted, or were shed, and the alveoli absorbed. The teeth in the aged skulls were much worn, and the crowns flattened but not decayed. From the dentition of the young skulls, they were children apparently of 8, 10, and 16 years.

In six specimens the sutures of the cranial vault had almost disappeared from senile obliteration, and in another they were partially synostosed. In many of the crania the sutures at and near the bregma were very simple in their denticulation. No skull was metopic. Wormian bones were present in several specimens in the lambdoidal suture, and in two crania a pair of large triquetrals occupied the lambda. In one a considerable epipteric bone was in each pterion, and in the child of 8 the left squamous temporal articulated directly with the frontal, but the right did not. The os planum of the ethmoid, though relatively small, was normal in shape. The maxillo-premaxillary suture was faintly seen in several adults, and more distinctly in the children on the anterior part of the hard palate. The malar bone was not divided. In many of the crania, both adults and two of the children, a denticulated suture passed through the inferior border of the orbit from the infraorbital foramen to the roof of the infraorbital canal, immediately internal to the malo-maxillary suture. In one adult the left auditory meatus

was greatly narrowed by a broad based exostosis projecting both from the anterior and posterior walls, whilst in the right meatus a smaller projected from the posterior wall only. Another skull had a similar exostosis from the posterior wall of the right meatus. A female skull had a third condyle at the basion. The dimensions of the lower jaw are given in the table; in no instance was it particularly massive. The intergonial and intersymphysial diameters closely approximated to each other.

The mean cephalic index of the eighteen adult skulls was 74: that of the nine males 74·4; that of nine females 73. The average was therefore in the upper term of the dolichocephalic series. The range in the males was from 70 to 78; in the females from 67 to 78. As the index of nine was 75 and upwards, these were all mesaticephalic. A child of 8 with a cephalic index of 82 was brachycephalic. The mean vertical index of sixteen adults was 73·5, that of seven males 74·1, that of eight females 72·87. The

TABLE XIV.—NEW ZEALANDERS (MAORI)—MALES.

	Collection,	Chal. Waikato.	Kapiti Island, E.U.A.M. A.	Kapiti Island, E.U.A.M. B.	Kapiti Island, E.U.A.M. C.	63c.	5.	Chastlands.	Aucklland.	Marlborough.
	Age,	Ad.	Ad.	Ad.	Ad.	Ad.	Ad.	Aged.	Aged.	Ad.
	Sex,	M.	M.	M.	M.	M.	M.	M.	M.	M.
	Cubic capacity,	1350	1318	1336	1520	...	1526	1356	1494	1586
	Glabello-occipital length,	178	179	180	196	195	192	182	194	199
	Ophryo-occipital ,,	177	177	174	193	194	189	178	188	196
	Basi-bregmatic height,	134	135	136	135	...	150	140	138	144
	Vertical Index,	*75*	*75*	*76*	*69*	...	*78*	*77*	*71*	*72*
	Minimum frontal diameter,	92	98	92	103	102	100	93	90	99
	Stephanic,	112	110	105	110	116	112	110	108	110
	Asterionic,	112	100	107	114	113	118	108	116	106
	Greatest breadth,	136	140*p*	136*s*	138*s*	142	143	138*s*	146*s*	144*p*
	Cephalic Index,	*76*	*78*	*76*	*70*	*73*	*74*	*76*	*75*	*72*
	Horizontal circumference,	501	516	504	550	547	532	514	540	542
	Frontal longitudinal arc,	126	120	127	130	140	132	133	144	133
	Parietal ,, ,,	123	134	110	136	125	139	112	126	130
	Occipital ,, ,,	115	110	120	115	...	114	133	118	131
	Total ,, ,,	364	364	357	381	...	385	378	388	394
	Vertical transverse arc,	304	298	298	310	310	324	308	304	306
	Length of foramen magnum,	35	31	32	37	...	35	31	36	40
	Basi-nasal length,	104	101	106	109	...	114	104	107	106
	Basi-alveolar length,	101	95	103	106	...	110	99	103	97
	Gnathic Index,	*97*	*94*	*97*	*97*	...	*96*	*95*	*96*	*91·5*
	Interzygomatic breadth,	132	134	137	144	...	146	138	144	...
	Intermalar ,,	116	120	124	132	125	128	121	124	129
	Ophryo-alveolar length,	94	82	91	98	86	87	88	91	93
	Naso-alveolar ,,	67	59	65	75	67	66	65	69	68
	Facial Index,	*71*	*60*	*66*	*68*	...	*59*	*64*	*63*	...
	Nasal height,	52	50	54	56	55	49	54	54	55
	Nasal width,	27	21	28	26	24	28	24	24	26
	Nasal Index,	*52*	*42*	*52*	*46*	*44*	*57*	*44*	*44*	*47*
	Orbital width,	37	41	37	48	40	39	40	40	40
	Orbital height,	35	32	32	36	34	34	36	34	37
	Orbital Index,	*95*	*78*	*86*	*75*	*85*	*87*	*90*	*85*	*92·5*
	Palato-maxillary length,	55	56	56	58	...	62	56	...	51
	Palato-maxillary breadth,	65	57	63	65	...	69	...	67	66
	Palato-maxillary Index,	*118*	*102*	*112*	*112*	...	*111*	...	...	*129*
Lower Jaw.	Symphysial height,	29	...	...	31	...	35	33	...	...
Lower Jaw.	Coronoid ,,	64	...	...	62	...	76	68	...	...
Lower Jaw.	Condyloid ,,	63	...	...	61	...	60	60	...	...
Lower Jaw.	Gonio-symphysial length,	89	...	...	95	...	88	96	...	...
Lower Jaw.	Intergonial width,	84	...	...	96	...	94	96	...	...
Lower Jaw.	Breadth of ascending ramus,	36	...	...	38	...	34	43	...	...

general mean as well as that of each sex was metriocephalic. The mean basi-bregmatic height of eight females was 134 mm., the maximum being 140 mm., and the minimum 125 mm. The mean corresponding height of eight males was 139, the maximum being 150 mm., the minimum 134 mm. In the males the height and breadth in two skulls were equal; in four the breadth exceeded the height, in two the height exceeded the breadth. In the females the breadth exceeded the height in four specimens, whilst in the other four the height was greater than the breadth.

The mean gnathic index in the males was 95·4, in the females 97; so that the average in both was orthognathous. None of the males exceeded 97, but one female reached 100 and another 103; both of these, therefore, were mesognathous. The mean nasal index was 47·5 in the males, and 51 in the females; the average in both was

TABLE XV.—NEW ZEALANDER'S (MAORI)—FEMALES.

	Collection,	Chal. East Cape.	Chal. Hawea.	Chal. Wellington.	Kapiti D.	Wanganui. 63a.	Whangarii.	Chastlands.	Auckland.	Otipopo.	Kapiti E.	Kapiti. F.	Auckland.
	Age,	Adult.	Ad.	Ad.	Aged.	Ad.	Aged.	Aged.	Aged.	Ad.	Aet. 8.	Youth, Aet. 16.	Aet. 10.
	Sex,	F.?	F.	F.?	F.	F.	F.	F.	F.	F.	...	...	...
	Cubic capacity,	1250	1216	1378	1326	...	1240	1364	1540	...	1472	1308	1405
	Glabello-occipital length,	182	180	182	195	188	180	182	193	180	178	177	177
	Ophryo-occipital ,,	181	178	180	194	188	179	180	189	180	178	179	178
	Basi-bregmatic height,	134	133	136	138	...	125	138	140	130	126	124	134
	Vertical Index,	*74*	*74*	*75*	*71*	...	*69*	*76*	*72*	*72*	*71*	*70*	*76*
	Minimum frontal diameter,	90	90	100	90	94	93	98	93	94	94	90	86
	Stephanic, ,,	98	102	108	103	110	108	114	110	103	111	109	103
	Asterionic, ,,	100	107	112	115	108	108	108	108	106	108	100	106
	Greatest breadth,	130*p*	128*s*	139*s*	130*s*	142	129	141*p*	138*p*	140	146*p*	128	137*p*
	Cephalic Index,	*71*	*71*	*76*	*67*	*75*	*72*	*77*	*71*	*78*	*82*	*72*	*77*
	Horizontal circumference,	502	495	515	534	525	502	512	530	510	507	493	494
	Frontal longitudinal arc,	132	114	127	131	140	...	135	130	124	132	123	130
	Parietal ,, ,,	127	...	127	113	140	...	127	135	110	117	127	125
	Occipital ,, ,,	113	...	126	139	...	...	113	125	122	121	113	116
	Total ,, ,,	372	360	380	383	...	352	375	390	356	370	363	371
	Vertical transverse arc,	298	284	303	300	315	...	310	304	293	304	288	295
	Length of foramen magnum,	31	34	29	36	...	37	33	33	32	36	35	34
	Basi-nasal length,	102	100	100	107	...	99	100	106	104	92	93	92
	Basi-alveolar length,	100	95	95	100	...	102	94	106	...	90	91	85
	Gnathic Index,	*93*	*95*	*95*	*93*	...	*103*	*94*	*100*	...	*98*	*98*	*92*
	Interzygomatic breadth,	120	...	134	...	...	131	134	...	...	120	113	110
	Intermalar ,,	110	114	122	...	114	109	120	116	...	105	103	98
	Ophryo-alveolar length,	98	85	82	92	90	83	83	90	...	80	70	71
	Naso-alveolar ,,	68	63	60	70	66	59	62	69	...	60	52	53
	Facial Index,	*82*	...	*61*	...	...	*63*	*62*	...	...	*67*	*62*	*64*
	Nasal height,	48	44	45	54	55	42	51	51	...	45	41	42
	Nasal width,	23	25	27	24	24	26	26	23	...	20	22	21
	Nasal Index,	*48*	*57*	*60*	*44*	*44*	*62*	*51*	*45*	...	*44*	*54*	*50*
	Orbital width,	35	37	38	40	36	41	40	40	38	35	33	31
	Orbital height,	33	33	33	37	35	34	33	33	36	33	30	31
	Orbital Index,	*94*	*89*	*87*	*92*	...	*83*	*82*	*82*	*95*	*94*	*91*	*100*
	Palato-maxillary length,	55	...	54	54	...	54	49	57	...	52	47	43
	Palato-maxillary breadth,	60	62	61	63	...	59	61	63	...	59	58	60
	Palato-maxillary Index,	*109*	...	*113*	*117*	...	*109*	*124*	*110*	...	*113*	*123*	*139*
Lower Jaw.	Symphysial height,	31	...	29	...	...	30	29	...	...	25	...	...
	Coronoid ,,	65	...	69	...	...	61	67	...	...	53	...	...
	Condyloid ,,	53	...	67	...	...	56	63	...	...	49	...	...
	Gonio-symphysial length,	87	...	91	...	...	80	84	...	...	77	...	...
	Intergonial width,	83	...	89	...	...	83	...	...	...	79	...	...
	Breadth of ascending ramus,	38	...	32	...	...	33	33	...	...	33	...	...

mesorhine; but of the males six were leptorhine and one platyrhine, whilst of the females three were platyrhine and three leptorhine. The mean orbital index in the males was 86, in the females 88; the average in both was mesoseme, but of the males three were megaseme and two microseme; and of the females three were megaseme and three microseme. In the three children the index in each case was megaseme. The mean palato-maxillary index was 114 in the adult males, and 113·6 in the females; in one male the breadth exceeded the length by only 1 mm.; the palato-alveolar region was mesuranic.

The mean internal capacity of fifteen adult crania was 1387 c.c.; eight probable males had a mean capacity of 1436 c.c.; seven probable females of 1330·5. The general mean of the whole series and of the males was mesocephalic; that of the females was microcephalic. Four males were megacephalic, two were microcephalic. Four females were microcephalic and only one megacephalic. Of the young crania, one, aged about eight, was megacephalic.

The characters of these New Zealand skulls may be summarised as follows:—dolichocephalic, but on the verge of mesaticephalic, metriocephalic, phænozygous, orthognathic, mesorhine, mesoseme, mesuranic, and mesocephalic.

COMPARISON OF THE CRANIA OF THE PACIFIC ISLANDERS.

As the collection of human bones formed by H.M.S. Challenger included crania from several of the smaller islands in the Pacific Ocean, I may take this opportunity both of comparing these skulls with each other, and of making a general survey of the cranial characters of the people of the South Sea Islands. Our knowledge of these islanders has been greatly extended of late years by the labours of missionaries, by commercial enterprise, and by the visits of ships-of-war of various nationalities. Numerous descriptions of the people, their physical characteristics, customs, implements, weapons, and language have been written, and crania have been collected and deposited in many European museums. In making this comparison, I shall avail myself both of the crania that I have personally examined and of the published descriptions of skulls so far as I have been able to obtain access to the literature of this subject.

From the descriptions which have been given of the aborigines of the South Sea Islands by numerous travellers, it is now generally admitted that two well-defined races can be recognised. The one, named Papuan or Melanesian, which occupies New Guinea and the smaller islands to the east, south, north, and west. This race is distinguished by its sooty-brown or black skin, black frizzly hair, and well-developed beard. The second, named brown Polynesian or Mahori,[1] which inhabits, as was recognised by Captain Cook, the islands in the more eastern part of the Pacific, from the Sandwich Islands in

[1] This term Mahori is suggested in the article South Sea Islanders, by W. L. Ranken, in *Journ. of Anth. Inst.*, vi. p. 223, 1877; also in Australasia, by A. R. Wallace, London, 1880, p. 261.

the north to New Zealand in the south. This race is distinguished by its light brown or somewhat yellow skin, straight black hair, and scanty beard. To these a third race has been added by the name of Mikronesians, which occupies the Pelew, Caroline, Marshall, and Gilbert Islands, scattered in the north-western parts of the Pacific. By many ethnologists these people are not regarded as a distinct type or race, but as a mixture of the Mahori with the Malay, and in a less degree of Papuan, Negrito, Chinese, and Japanese elements.[1] The Challenger collection included crania both of the Papuan and brown Polynesian races, but none from the islands of the Mikronesian group.

The description by Prof. Moseley of the Admiralty Islanders (p. 52) makes it quite clear that in the black-brown colour of the skin of the adults, and in the frizzled hair, which formed a dense mop, these people presented Papuan characters; though, as regards the hair on the face, bushy whiskers and beard seemed to be the exception.

If their crania be compared with those of the Australians they will be found to differ both in general appearance and in many characters which can only be arrived at by the use of cranio-metrical methods. Thus the Australian skulls were heavier, with thicker walls, stronger ridges and processes for muscular attachment, much more projecting glabella and supraciliary ridges, with consequently a much deeper depression at the fronto-nasal suture, and the appearance of a more receding forehead. Further, the summit of the cranium in the Australians was roof-shaped, and exhibited more distinctly an ill-filled character. Both races were dolichocephalic. When the corresponding measures of the skulls of the Admiralty Islanders and of the Australians measured by myself are compared, it will be seen that the mean length-breadth index was equal in the two peoples, but whilst the males were somewhat higher than the females in the Admiralty Islanders, they were below them in the Australians. The vertical index was higher (72) in the Admiralty Islanders than in the Australians (70); but whilst the difference in the two sexes was very slight in the Australians, it was marked in the Admiralty Islanders, the males being 73, the females 70. Both races were microcephalic as regards their cranial capacity, but whilst the Australians, both male and female, were on the average micro-cephalic, the mean of the male Admiralty Islanders was mesocephalic. The Australian crania were distinctly phænozygous, the Admiralty islanders as a rule were cryptozy-gous. The Australians were less prognathous than the Admiralty Islanders. The nasal index was higher in the Australians than in the Admiralty Islanders, so that whilst the former were platyrhine, the latter were on the line between the leptorhine and mesorhine. In both peoples the orbital index was mesoseme, but in the Admiralty Islanders it was slightly higher than in the Australians, in whom it was on the verge of microseme. The palato-maxillary index was higher in the Admiralty Islanders than in the Australians; in the latter it was dolichuranic, in the former mesuranic.

[1] See Mr. A. H. Keane's Appendix, p. 617, to Wallace's Australasia, already quoted.

But the two races differed from each other in important external physical characters. The hair of the scalp, though black in both, was straight and smooth in the Australian, but fine curly in the Admiralty Islander, and formed in him "a dense mop projecting in all directions 6 to 8 inches from the head." The beard and whiskers were as a rule scanty in the Admiralty Islander, but fairly developed in the Australian. In both, the skin was black or black-brown, though Moseley states that the Admiralty Islander youths of both sexes were as a rule much lighter than the adults, and that he saw one man and two women whose skins were of a light yellow colour. The lips were thick and projecting in the Australians, but not unusually large and prominent in the Admiralty Islanders. Prof. Moseley speaks of a well-marked depression usually present at the root of the nose, so that the brow is somewhat overhanging. From the feeble glabella in most of the crania, granting that they belong to the same race as the living islanders, the projecting brow must be due to thickened skin and subcutaneous tissue, whereas in the Australian it is largely produced by the thickening of the frontal bone. In both races the nose was short and with dilated alæ, but the nostrils were not platyrhine in the Admiralty Islanders, whilst in the Australians the plane of their opening was directed downwards, forwards, and outwards; again, about one in every fifteen or twenty Admiralty Islanders had a long Jewish nose. The conclusion therefore to which one has come from this comparison, is that the Australians and Admiralty Islanders are two distinct races.

I shall now pass to the consideration of the characters of the crania of the people occupying the other islands of the Melanesian area. From its size and importance as the chief seat of the Papuans I shall begin with *New Guinea*.

Material for the determination of the cranial characteristics of the people of New Guinea has been accumulating during the last few years. Though still far from perfect, especially as regards the people of the interior, numerous crania are now in European museums, and a large number have been measured and described. MM. de Quatrefages and Hamy have made a critical examination of the literature of this subject up to the date of publication of their fasciculi on the 'Négrito-Papoue' and 'Papoua' races, and have brought together in a form convenient for reference, a mass of information of which I shall avail myself, though at the same time I shall have to refer to other and subsequent writers and to some specimens not previously described. The north-west end of New Guinea is the part of the island from which the greatest number of crania have been obtained, but the southern seaboard, the south-eastern peninsula, the small islands in Torres Straits, and the course of the Fly River, have also contributed important material.

As a result of the examination of the skulls from these several localities it is evident that a considerable variety in form and proportions has been observed, some being decidedly brachycephalic, others mesaticephalic, others dolichocephalic.

We may first inquire into the evidence which has been recorded of the presence of

brachycephalic and mesaticephalic people either in New Guinea or the adjacent islands. MM. Quoy and Gaimard visited, during the voyage of the "Uranie," the islands of Rawak and Waigiou, situated off the extreme north-west of New Guinea, and gave an account of the people.[1] From their description the crania are short, broad, and high, and they state that their heads are flattened both anteriorly and posteriorly, and in the plate accompanying their description, where two skulls of natives of Rawak are figured, both crania are seen to have well-marked parieto-occipital flattening, and although no measurements are given, they are obviously brachycephalic. MM. de Quatrefages and Hamy have described, in more detail,[2] the crania collected in Rawak and in the adjacent islet of Boni. In one skull the cephalic index was 88, and the average of five skulls was 86, so that their brachycephalic character is unquestionable, whilst the parieto-occipital flattening is strongly marked. The crania observed at Waigiou by the naturalists of the "Coquille" are described as remarkable for a considerable posterior flattening, and, from measurements given by M. Garnot, the cephalic index is 81·8.

In 1856 Prof. Retzius stated[3] that the museum of the Caroline Institute of Stockholm had received from Dr. Wise of Edinburgh three crania of brachycephalic Papuans, which had a striking resemblance to each other and to the crania described by MM. Quoy and Gaimard. MM. de Quatrefages and Hamy have pointed out[4] that the crania collected by Wise were of the tribe of Karons, a people occupying a chain of mountains, originally known as Arfak, in the north-west part of New Guinea, parallel to the north coast and adjacent to Port Dorey. A description of these crania has been given by MM. de Quatrefages and Hamy, one of whom visited Stockholm for the purpose of studying them. Two of these three crania were not flattened in the parieto-occipital region, one of which had a cephalic index of 78·8, the other of 78·3. Their volume was not large, the mean horizontal circumference 492 mm., the capacity 1370 c.c. The antero-posterior maximum of the one 175 mm., and of the other 171 mm. The third specimen had, however, a distinct parieto-occipital flattening, and was obviously brachycephalic. Its antero-posterior maximum was the same as the glabello-iniac, 174 mm., the transverse maximum was 146, and the cephalic index was consequently 83·9. Another cranium, from Amberbaki, adjacent to the country of the Karons, collected by M. Beccari, has been described by MM. Incoronato and Tocco.[5] This skull, apparently that of a woman, had a capacity 1243 c.c., and a horizontal circumference 481 mm. Its antero-posterior max. was only 167 mm., its transverse max. 136 mm., and its cephalic index 81·4.

[1] *Annales des Sciences Naturelles*, t. vii. p. 27, pl. iii., 1826. Figures of one of these skulls are reproduced by von Baer in Crania selecta, pl. iii. figs. 4, 5.

[2] Crania Ethnica, p. 210.

[3] Forhand. ved de Skandin. Naturforsk, Christiania, July 1856; and Ethnologische Schriften, Leipzig, 1864, p. 145.

[4] Crania Ethnica, p. 201.

[5] *Archivio per l'Antropologia*, lib. iv., 1874, and *Boll. della Soc. Geograf. Italiana*, 1874, quoted by de Quatrefages and Hamy, p. 204.

Sandifort has also described[1] a brachycephalic Papuan cranium with a cephalic index of 85, and one with a cephalic index of 83 is in the collection (No. 1401) of Dr. Barnard Davis,[2] but the exact localities from which these skulls were procured does not seem to have been ascertained.

In the magnificent collection of crania formed by Dr. A. B. Meyer[3] certain skulls possessed a high cephalic index. Of the twenty-three crania obtained by him from Rubi, near to the south end of Geelvink Bay, three had the indices respectively of 77·7, 76·4, 76·4; and of the one hundred and twelve skulls collected at Kordo, on the island of Mysore, at the mouth of the same bay, several had an index above 75. From an analysis which Dr. Meyer has made of the "normal" series of one hundred and thirty-four crania, one hundred and two have a length-breadth index below 75, twenty-five between 75 and 80, and three only above 80; whilst of the adult crania, eighty-six in number, it would appear that of fifty-four males, forty-three had a cephalic index below 75, nine between 75 and 80, and two above 80; and of thirty-two females, thirty were below 75 and two between 75 and 80. These "normal" crania gave no evidence of premature ossification of sutures, or of deformity produced by artificial means. They are considered by Dr. Meyer to be Papuans, and not to contain any mixture of Malays; whilst on Waigiou partially, and on the smaller Papuan islands more to the west, there is, he says, an undoubted mixture of Malays and Papuans.

In 1874 Miklouho-Maclay described[4] three crania, which he had collected in 1872 at the villages of Englam, Mana, and Gumbu on the Maclay coast of New Guinea. He says that the skulls were remarkably brachycephalic, their indices being respectively 81·2, 82·5, and 86·4. In another paper[5] he stated as the result of a great number of measurements that the cephalic index of the New Guinea skulls varied from 62 to 84.[6] Of two skulls collected in Astrolabe Bay on the north-east coast of New Guinea, described by Prof. Virchow,[7] one is said to have a length-breadth index of 78·2, whilst the other is very prognathic, and long and narrow, so that its breadth index is only 72·7. M. Mantegazza has also given evidence of the occurrence of brachycephalic crania amongst the Papuans.[8] These crania, according to him, are small, with large parietal

[1] Tabulæ Craniorum. [2] Thesaurus Craniorum, p. 305.

[3] Dr. Meyer's important memoirs are contained in the *Mittheilungen aus dem k. Zoologischen Museum zu Dresden*, May 1875, October 1876, and December 1878.

[4] Verhand. der Berliner Gesell. für Anthropologie, in *Zeitschr. für Ethnologie*, Bd. vi. p. 177. The name of this Russian traveller is sometimes printed Miklucho-Maclay, at others as in the text.

[5] *Natuurk. Tijdschrift*, Batavia, xxxiv. p. 345, 1874.

[6] In a communication made to the Berlin Society of Anthropology (*Zeitschr. für Ethnologie*, Bd. xii. 374, 1880), and to the Linnean Society of N. S. Wales, *Nature*, vol. xxiv. June 16, 1881, Miklucho-Maclay gives as a result of his travels in Melanesia, that brachycephalism has a much wider range than is usually supposed. He has measured both skulls and heads, and states that the breadth index in many cases exceeds 80 and sometimes 85.

[7] Verhand. der Berlin. Gesell. für Anth., in *Zeitschr. für Ethnologie*, Bd. v. S. 70, 1873.

[8] Studii antropol. ed etnog. sulla Nuova Guinea, 1877; Abstract in *Jahresb. der Anat. und Phys.*, 1881, p. 361. In the *Bull. de la Soc. d'Anthrop.*, 19th Feb. 1880, he says that in d'Albertis's collection are skulls of the Negrito type, brachycephalic in proportion.

eminences, and the mean index of eight skulls was 83·1. Of the fifteen crania collected by Dr. Comrie on the south-east coast of New Guinea, thirteen of which are now in the Museum of the Royal College of Surgeons, London, and the measurements of which are given by Prof. Flower,[1] one from Traitor's Bay, near Riche Island, and another from Lydia Island, have cephalic indices respectively 81 and 82·5, whilst a third from the D'Entrecasteaux Islands has an index 77. The two remaining crania were presented by Dr. Comrie to the Anatomical Museum of the University of Edinburgh. The one from Possession Bay has a cephalic index of 68; this skull is markedly dolichocephalic. The other, from D'Entrecasteaux Island, has a cephalic index of 80·5, so that it falls within the numerical brachycephalic index.[2] Three other skulls in the College of Surgeons Museum, one of which is from an island in Torres Straits and two from Airds River, Gulf of Papua, have also brachycephalic proportions.

Brachycephalic crania have also been procured on Warrior Island (l'île Toud) in Torres Straits. I described and figured one with well marked parieto-occipital flattening from this island in 1880,[3] which had a cephalic index 88 and a vertical index 78; and MM. de Quatrefages and Hamy had previously described and figured from the same island crania with brachycephalic proportions. The well-known Italian traveller Signor D'Albertis has figured[4] a number of the skulls which he collected in his expeditions, and these have now been carefully measured and described by MM. Mantegazza and Regalia.[5] Of the twelve crania collected on Kiwai Island at the mouth of the Fly River, ten had a length-breadth index of 76 or upwards, and of these four were upwards of 80, four between 77 and 80, and two between 76 and 77. Of the four crania collected on Canoe Island, a little higher up the same river, three had the cephalic indices 88·9, 85·8, and 80·8, whilst one was 76·1.

From the examination of the living people of New Guinea, made by M. Jacquinot, from the casts of the head taken by M. Dumoutier, from the description of several of the crania given by MM. de Quatrefages and Hamy, from the configuration of the Warrior Islander skull described by myself, from the photographs of a skull from Canoe Island and one from Kiwai in the D'Albertis collection published by MM. Mantegazza and Regalia, there can, I think, be no doubt that the practice of artificially flattening the back of the head, and in the Canoe Island and Kiwai skulls the forehead also, prevails to a considerable extent amongst individuals, and, it may be, also tribes of the natives of

[1] Catalogue of Crania, p. 218, *e. s.*

[2] The measurements of these skulls are given in Table XVI., p. 89.

[3] Two Masks and a Skull from islands near New Guinea, *Journ. Anat. and Phys.*, July 1880, vol. xiv. p. 479. The measurements are given in Table XVI. *supra*. In the British Museum is a prepared and decorated skull marked "Native chief of Nagheer Island, Torres Straits," with a wooden nose, and with the orbits filled up just as in the skull which I have described from Warrior Island. It was flattened both frontally and occipitally, and obviously brachycephalic.

[4] New Guinea, What I did, and what I saw, London, 2nd ed., 1881.

[5] *Archivio per l'Antropologia e la Etnologia*, lib. xi. Fasc. 2, 1881.

New Guinea and the adjacent islets, as far apart as Waigiou and Rawak on the west, Warrior Island on the south, and apparently D'Entrecasteaux Island on the east. At the same time there can be no doubt that this practice does not prevail generally in all the people of New Guinea, as numerous crania of dolichocephalic proportions have been examined in which there is no evidence of artificial parieto-occipital flattening. It should also be stated that many of the skulls possessing high cephalic indices have also been characterised by distinct parieto-occipital or frontal flattening, and the influence which artificial pressure, applied during infancy to the frontal and occipital regions, has exercised either in producing or exaggerating brachycephalic proportions is a factor which should not be left out of consideration in the study of these crania.

The evidence of the presence of a dolichocephalic people in New Guinea is also very complete. MM. de Quatrefages and Hamy have critically examined the older literature on this subject. In the north-west, Port Dorey, Mansinam, Salwatti, the Wandessa tribe of Geelvink Bay, the island of Jobie at the mouth of the same bay, have all furnished crania of these proportions. Dr. Meyer's collection from Rubi, although, as already stated, containing three mesaticephali, had twenty skulls with a length-breadth index below 75. The collection formed by the same energetic naturalist in Kordo, Mysore, had a very large proportion of the skulls dolichocephalic. In his analysis of the eighty-six "normal" adult skulls, Dr. Meyer states that, of the fifty-four males, forty-three were below 75, and of the thirty-two females, thirty were below 75. In the mountains of Arfak also a dolichocephalic people reside, and MM. de Quatrefages and Hamy give, in their twenty-fifth table, 69·3 as the length-breadth index of five males, and 73·9 as the corresponding index of two females. Even on the small Warrior Island dolichocephalic skulls were obtained by the naturalists on board the "Astrolabe" and "Zelée." MM. de Quatrefages and Hamy state (p. 254) that eight crania from this island exhibited purely Papuan characters; seven of these were males, and they have a mean cephalic index of 71·8 and a mean vertical index of 73·3. A ninth skull again gave a mixture of Papuan and Negrito-Papuan characters. The majority of the crania collected by Dr. Comrie during the voyage of the "Basilisk" on the south-east coast of New Guinea were markedly dolichocephalic. Dolichocephalic skulls from Erroob or Darnley Island and from Wallis Island, Endeavour Strait, are in the Museum of the Royal College of Surgeons. The D'Albertis collection of crania, measured by MM. Mantegazza and Regalia, contains twenty-one skulls, thirteen males and eight females, from the interior of New Guinea, collected from houses on the banks of the Fly River; the maximum cephalic index in these specimens was 77 and the minimum 67·7, and both were males; the mean of the series of males was 71·9, that of the females was 72·5. Two male crania from Baduhubere, an inland place to the west of the mouth of the Fly River, had the cephalic index of 66·1 and 75·8. Of the Kiwai group of skulls already referred to (p. 86), only two had a cephalic index below 75, and the lowest index of the Canoe Island group was 76.

The Anatomical Museum of the University of Edinburgh has recently acquired some skulls from New Guinea, to which I may now refer. To the Rev. S. Macfarlane I am indebted for a specimen from Jarvis Island,[1] Torres Straits, and from a former pupil, Mr. A. F. Davenport, I have received two specimens from Tomara, Cloudy Bay, on the south-east coast.[2] The principal dimensions, along with those of the two specimens presented by Dr. Comrie, referred to on p. 86, and the Warrior Islander, are given in Table XVI. The Jarvis Islander and the adult from Tomara were both distinctly dolichocephalic; whilst the young child from the latter place was brachycephalic, and its greater breadth was obviously due to an essential difference in the proportions of the skull, and not to a mere difference in age. In the Jarvis Islander the vertex was roof-shaped. The skull was smeared with a red pigment. A broad tongue of the squamous temporal, 19 mm. in vertical diameter, joined the frontal; the antero-posterior diameter of the temporal fossa was only 102 mm. The vertical and cephalic indices were equal, and there was marked prognathism and an unusually low palato-maxillary index. In the adult Tomara skull a process of the squamous temporal, 6 mm. in vertical diameter, articulated with the right frontal, whilst two epipteric bones were in the left pterion. The Tomara child's skull had a steep descent from the obelion into the occipital region as if from artificial flattening.

There is now on record also a considerable body of evidence to enable one to come to some conclusion as to the relations of the vertical to the cephalic index in the New Guinea skulls. The mesaticephalic Karons tabulated by MM. de Quatrefages and Hamy, in their Table XX., had for the male a vertical index of 74·2 and for the two females a mean vertical index of 75·73, as against the cephalic indices 78·8 and 79·8 respectively. The brachycephali from Rawak and Boni, in the same table, with a mean cephalic index 86·4, had a length-height index 82·7. A brachycephalic skull from Lydia Island, East Cape, Comrie collection, cephalic index 82, had a vertical index 76, and in a D'Entrecasteaux specimen from the same collection (my Table XVI.) these indices were equal. In my Warrior Island skull, and in the brachycephalic specimen in the Paris Museum, the cephalic index was much above the vertical, and these specimens were distinctly deformed from artificial flattening. The brachycephali and four of the mesaticephali from Kiwai and Canoe Island had the vertical index markedly below the cephalic, and in two only of the mesaticephali had the vertical index the superiority. Hence it would appear that in the crania with high cephalic indices the greatest transverse breadth was as a rule in excess of the basi-bregmatic height.

In the dolichocephalic Papuan crania, on the other hand, an opposite condition

[1] This skull was procured from the Sacred House on Jarvis Island. It was probably the skull of a head taken in battle.

[2] These specimens were collected by Lieut. Thos. de Hoghton of H.M.S. "Beagle." They were found in a native's house.

of these indices would appear to prevail. From MM. de Quatrefages and Hamy's twenty-fourth table, which includes Dr. Meyer's Rubi and Kordo crania, along with specimens from Dorey, Salwetti, Wandessa, and Jobie, the mean vertical index, except in the Jobie skull, exceeded the cephalic, and a similar relation is shown in the male Arfaks, though not in the female, measured in their twenty-fifth table. Eight dolichocephalic skulls in Dr. Comrie's collection in the Museum of the Royal College of Surgeons had the vertical index greater than the cephalic, in one it was less, and in two mesaticephali these indices were equal. In three of the five Erroob crania measured by Prof. Flower the vertical index exceeded the cephalic. In the pure Papuan male crania from Warrior

TABLE XVI.—NEW GUINEA.

Collection,	Warrior Island, Torres St.	Jarvis Island, Torres St.	Possession Bay, Dr Comrie.	D'Entrecasteaux Island, Dr C.	Tomara, Cloudy Bay.	Tomara, Cloudy Bay.
Age,	Adult.	Adult.	Adult.	Adult.	Adult.	Child, 6 or 7.
Sex,	M.	M.	...	F.	...	...
Cubic capacity,	1534	1230	...	...	...	1430 *ap*
Glabello-occipital length,	175	178	178	169	179	172
Ophryo-occipital „	173	176	178	170	178	172
Basi-bregmatic height,	137	130	...	136	...	125
Vertical Index,	*78*	*73*	...	*80·5*	...	*73*
Minimum frontal diameter,	103	90	90	96	94	87
Stephanic „	122	105	106	110	104	114
Asterionic „	120	106	101	103	100	108
Greatest parietal breadth,	154	130*s*	122*s*	136*s*	124*p*	142*p*
Cephalic Index,	*88*	*73*	*68·5*	*80·5*	*69*	*82·6*
Horizontal circumference,	515	494	488	489	494	498
Frontal longitudinal arc,	130	122	122	125	118	124
Parietal „ „	135	132	128	138	127	128
Occipital „ „	109	106	...	...	...	108
Total „ „	374	360	...	...	...	360
Vertical transverse arc,	330	280	280	293	277	310
Basi-nasal length,	105	99	...	94	...	90
Basi-alveolar length,	107	108	...	90	...	88
Gnathic Index,	*102*	*109*	...	*96*	...	*98*
Interzygomatic breadth,	140	122	122	128	...	109
Intermalar „	125	113	112	111	...	103
Ophryo-alveolar length,	90	90	89	78	81	73
Naso-alveolar „	65	68	68	60	60	59
Facial Index,	*64*	*74*	*73*	*61*	...	*67*
Nasal height,	47	46	47	46	44	43
Nasal width,	24	24	22	22	25	20
Nasal Index,	*51*	*52*	*47*	*48*	*57*	*46·5*
Orbital width,	...	39	38	37	36	35
Orbital height,	...	29	31	34	33	31
Orbital Index,	...	*74*	*82*	*92*	*92*	*88·6*
Palato-maxillary length,	64	65	58	52	52	45
Palato-maxillary breadth,	69	62	63	66	57	...
Palato-maxillary Index,	*108*	*95*	*108·6*	*127*	*109·6*	...

Island in the Paris Museum, the basi-bregmatic height exceeded the greatest transverse diameter, but in a female skull from the same island the opposite relation occurred. In nine of the thirteen male crania from the inland district of the Fly River collected by D'Albertis the vertical index was above the cephalic, but in three only of the eight female crania did a similar relation prevail.[1]

So far then as one can base conclusions on these characters of the crania, two very distinct types of skulls have been procured in New Guinea, which must without doubt be regarded as indicating the presence in and around that island of more than one race of men. The testimony of several travellers points also to a similar conclusion. The Rev. S. Macfarlane, who for so many years has been engaged in missionary work amongst these people, states[2] that the bush tribes are greatly inferior both mentally and physically to the coast tribes, and that the latter have driven the aboriginal bush tribes into the interior. Signor d'Albertis makes frequent reference[3] to differences which he observed both in the form of the head and in the customs of the people of the interior and those of the coast. He regards it as certain that many races or varieties have come in contact, and that they are more or less mixed in the district of the Fly River. To all appearance the aborigines of New Guinea, who are most numerous and most widely diffused throughout the island, are a dolichocephalic people, constituting the Melanesian or Papuan element, which probably preserves its purity in the interior of the island; though from the great preponderance of dolichocephalic skulls obtained by Dr Meyer from Rubi and Mysore, it is also obvious that there are parts of the coast where skulls of this type abound.

But from its geographical position New Guinea is on the high road between the Pacific and the Indian Oceans, and a stream of migration both from the west and from the east seems to have flowed around its shores. From the east it has received without doubt colonies of brachycephalic Polynesians, who have occupied the Louisiade Archipelago and the adjacent coasts of the main island. From the west it has been, and is indeed at the present day, visited by the brachycephalic Malays for purposes of trade, who have established themselves at Salwatti and the adjacent parts of the west coast. To the west it is also brought into relation with the brachycephalic, short-statured Negrito. In some localities on the seaboard, or the adjacent small islands, immigrant races may have entirely displaced the aborigines; in others it is not unlikely that an intermixture of a foreign with the proper native Papuan race may have taken place, and according to the extent of that intermixture would the physical characters and the customs of the people of the locality undergo a modification. The presence of a Negrito element in New Guinea, more especially in the mountainous district in the north-west, has also been strongly insisted on by MM. de Quatrefages and Hamy, and the brachycephalic Karons (p. 84) are regarded by them as exhibiting characters which closely

[1] See Mantegazza and Regalia's third table.

[2] *Athenæum*, December 2, 1876.

[3] New Guinea, vol. ii.

approximate to the Negrito race. It is of course a question for consideration whether the Negritos or the Papuans are the primitive inhabitants of New Guinea. The Papuans are undoubtedly the more vigorous race, and it is not unlikely that they may have to a large extent displaced and driven to the mountains, or perhaps somewhat intermingled with, a more feeble pre-existing Negrito population.

There is, however, in the study of the crania collected in New Guinea, an element of uncertainty which should not be lost sight of; as, from the practice of head hunting and preserving, it is not possible to pronounce definitely whether those skulls collected by several travellers, which had been preserved as trophies, really belonged to the race occupying the spot where the skulls were obtained, or had belonged to people of some other tribe or race conquered in war. The Rev. S. Macfarlane has given an interesting explanation of how it is that in these trophies the lower jaw so seldom accompanies the skull, for the man who first wounds the enemy gets the one, whilst he who kills and beheads him gets the other. It will require therefore a more intimate knowledge of New Guinea than we yet possess to enable ethnologists to state precisely the exact distribution of the brachycephalic and dolichocephalic races in that island, and this result can only be attained with accuracy when a sufficient number of skulls known to have belonged to the people occupying each district has been obtained.[1]

The Australian race, though separated by a strait only about 80 miles wide at Cape York from New Guinea, has not apparently exercised any influence there. For the northern Australians, although they make canoes, are not a seafaring people, and they are much inferior in civilization to the Papuans. There is indeed one island in Torres Straits, Kowrarega, inhabited according to Macgillivray[2] by a mixed race, formed by a complete fusion of the Papuans with the Australians. The Papuans, on the other hand, do seem to have somewhat modified the characters of the tribes inhabiting the north coast of Australia. Mr. Paul Foelsche, who lived for a number of years in the Northern Territory of Australia, states[3] that the hair of the head of the men is invariably thick and curly, and he has met with instances where it strongly resembles that of the Papuans, but these are very rare. In the women, as a rule, the hair is with few exceptions not so curly as that of the men.

The archipelago immediately to the north and east of New Guinea, of which the Admiralty Islands form almost the western limit, is also inhabited by a Melanesian people.

The people of *New Britain* are, according to Dr. Finsch,[4] pure Melanesians, their hair

[1] Dr. O. Finsch in his Anthropologische Ergebnisse, 1884, expresses his belief that the people of the south-east coast from Fresh Water Bay to Keppel Bay, also those of the islands in Torres Straits, of Saibai Island and of Salwatti in the extreme north-west, are all of the same race, *i.e.*, pure Melanesians.

[2] Voyage of the "Rattlesnake," 1852.

[3] Notes on the Aborigines of North Australia, *Trans. and Proc. of Roy. Soc. of South Australia*, Adelaide, 1882, p. 1.

[4] Anthropologische Ergebnisse einer Reise in der Südsee, Berlin, 1884.

and skin being characteristically Papuan. The Godeffroy Museum in Hamburg contains one hundred and fifty skulls from the New Britain Archipelago, twenty-six of which are from the principal island, New Britain, and one hundred and twenty from the small island Mioko in the Duke of York group. These skulls have been examined and their characters analysed by Dr. Rud. Krause.[1] The chief measurements are as follows :—the mean length 181 mm., maximum 195, minimum 165 ; the mean greatest breadth 130·9, maximum 142, minimum 119 ; the mean height 137·6, maximum 150, minimum 128. The indices are as follows :—length-breadth 72·3, length-height 76, breadth-height 105·1. The cubic capacity varies from 1530 to 990, that of the males having a mean of 1267 c.c., that of the females of only 1180 c.c. Prof. Virchow states[2] that he has been put in the position of obtaining through Dr. Finsch one hundred and fifty crania from New Britain. He refers to the great variation in their cubic capacity, and cites a male skull having a capacity of 2010 c.c. and a female of only 1140 c.c., but he gives no other measurements.

New Hanover and *New Ireland*, situated to the north and west of New Britain, were visited in 1875 by the Prussian war-ship "Gazelle," and a description of the people and their customs has been written by Captain Strauch.[3] From the character both of the hair and skin they are evidently in the main Papuans, though it is possible that here, as elsewhere in the Melanesian Islands, there may have been some intermixture of Mahori blood. Numerous crania were collected, which are now in the Anatomical Museum of the University of Berlin. The majority have been measured by Dr. Rabl-Rückhard, and their characters are recorded by him.[4] I am indebted to that gentleman for an early proof of his important communication. The skulls from New Ireland were collected at a spot which had been used for cannibal feasts, and they were so defective that a proper series of measurements could not be taken. Forty-five specimens belonged in all probability partly to New Britain and partly to New Hanover, but in the table of measurements they are all placed under the heading New Hanover. Dr. Rabl-Rückhard has measured the greatest length from both the fronto-nasal suture and the glabella, and has given the cephalic index in relation to both these measurements. When the glabello-occipital diameter is used to compute the cephalic index, I find that by far the greater number of these skulls have a length-breadth index of less than 75, as many indeed as seventeen being below 70, whilst only six are above 75, and the highest of these is 77·6. These people therefore are undoubtedly dolichocephalic. It is also important that in only one instance was the vertical index below the cephalic, and in only one were they equal ; in all the other skulls the vertical index exceeded the cephalic, and in many specimens in a

[1] Die ethnographisch-anthropologische Abtheilung des Museum Godeffroy, Hamburg, 1881.
[2] Versamml. der deutschen Anthrop. Gesellsch., 1882, reported in *Archiv für Anthrop.*, Bd. xiv., 1883, p. 89.
[3] *Zeitschrift für Ethnologie*, Bd. ix. pp. 9, 81, 1877.
[4] *Archiv für Anthropologie*, Bd. xv., 1884, parts 1 and 2, supplement.

very marked manner, as may be seen in the following examples:—C.I. 68·9, V.I. 77·6; C.I. 68·1, V.I. 80·2; C.I. 70·5, V.I. 79·3; C.I. 64·9, V.I. 74·2; C.I. 71·3, V.I. 81·3. In this series of skulls Dr. Rabl-Rückhard regards fourteen as men, six as women, whilst the sex of the remaining twenty-five could not be determined with accuracy.

Skulls, preserved heads, and busts from the *Solomon Islands* are in several museums. Mr. Webster describes[1] the natives of San Christoval as almost black, with woolly hair and Papuan countenances. Captain Strauch states that the people who visited the "Gazelle" at Bougainville were well built, extremely dark, with compact hair sticking far out. But mingled with the people possessing Melanesian characters other travellers have seen natives with fairer skins and long smooth hair, resembling the Mahori or Polynesian race.[2] Four busts of natives of the island Isabel are in the Dumoutier collection in the Paris Museum. They exhibit, as MM. de Quatrefages and Hamy have shown, two distinct types; the one brachycephalic, the other dolichocephalic. Prof. Virchow saw on board a ship in Hamburg a native of the island Morissi.[3] His skin was coloured a rich, shining blackish-brown, almost chocolate. The hair of the head was short, frizzly, black, without, however, being arranged in bunches. The length of the skull was 174·5 mm., its greater breadth 145·5, giving an index 80·2.

Skulls or preserved heads are in the Barnard Davis collection, the Godeffroy Museum, the Museum of the Royal College of Surgeons, the Paris Museum, and that of the University of Edinburgh.[4] Of these thirteen specimens, four have the cephalic indices respectively 75, 76·3, 76·5, 79; whilst the remaining eight are below 75, and have a mean length-breadth index 71. In eight specimens the height of the skull has been measured and the vertical index computed. In the skull with the cephalic index 79, from Makira, in the Barnard Davis collection, the vertical index was also 79, and in one from Isabel measured by Prof. Flower the two indices were respectively 75 and 75·6, but in the other specimens the vertical index decidedly exceeded the cephalic. The skulls, though in the main dolichocephalic, yet present individual specimens which approximate to the brachycephalic standard. In this respect the crania bear out the statements of travellers that whilst the people are mainly Papuan, another race is intermingled with them.

New Caledonia lies to the southward of the Solomon Islands, and the people in their hair and skin have strong Papuan features. The Rev. G. Turner says[5] that the people

[1] The last cruise of the "Wanderer," Sydney, 1863, cited in Thesaurus Craniorum.

[2] Die Inseln des stillen Oceans, by Prof. Meinicke, p. 160, Leipzig, 1875.

[3] Verhandl. der Berliner Gesellsch. für Anthrop. in *Zeitschr. für Ethn.*, Bd. ix. p. 241, 1877.

[4] Two preserved heads from Rubiana, a small island about seven miles to the northward of Rendova Bay in New Georgia, one of the Solomon Islands, were presented to me by Dr. J. C. Cox of Sydney, and are now in the Anatomical Museum of the University of Edinburgh. They were procured by Lieut. Farie, who wrote to me that the Rubiana men are fierce and warlike. Probably these heads are trophies, and may have belonged to natives of New Georgia, with whom the Rubianans are frequently at war.

[5] Samoa, a hundred years ago, p. 340, London, 1884.

resemble the Fijians in colour and figure, though the dialects are widely different. Owing to the colonisation of this island by the French, numerous crania are deposited in museums in that country; the Barnard Davis collection contains a few specimens; two specimens were collected by the "Novara"[1] and six specimens are in the Senckenberg Museum in Frankfort.[2] M. Bourgarel has also made a communication on the skulls of these people.[3] Dr. Bertillon has described the crania in the Museum at Caen,[4] and the fine collection in the Museum of Natural History in Paris has been carefully studied by MM. de Quatrefages and Hamy.[5]

The last-named authorities separate the skulls into two groups, those which belong to the Kanala and other tribes living in the north-east of the island, and those from tribes elsewhere, more particularly in the west. The Kanala crania show certain differences in proportion as compared with the tribes in the west. Thus twenty-five males have a mean cephalic index 71·3 and a mean vertical index 75·1, and twenty-six females have a mean cephalic index 74·4 and a mean vertical index 75·5; whilst the more western tribes have in forty-three males a mean cephalic index 69·6, and a mean vertical index 74·4, and twenty-eight females have a mean cephalic index 72·4 and a mean vertical index 74·7. All are dolichocephalic, but this character is more pronounced in the tribes of the west than of the east. In all, the vertical index dominates over the cephalic, and the greater relative height of the skull is more strongly marked in the western than in the north-eastern tribes. These and other differences in the cranial characters of the people in New Caledonia, MM. de Quatrefages and Hamy ascribe to the intermixture of Polynesian immigrants during the last century. Three crania in the Barnard Davis collection from the northern extremity of this island[6] have the following indices respectively—cephalic 72, 72, 78; vertical 74, 85, 80.

The people of the Isle of Pines, a dependency of New Caledonia, are also in the main dolichocephalic. MM. de Quatrefages and Hamy, in their twenty-eighth table, state that seven males have a mean cephalic index 67, and a mean vertical 72·2; six females have a mean cephalic 68·5, and a mean vertical index 73·4. The skull in the Barnard Davis collection, and six specimens in the Museum of the Royal College of Surgeons, are all dolichocephalic, except one specimen, the cephalic index of which is given by Prof. Flower as 76; but in all the height exceeds the breadth. De Quatrefages and Hamy mention that some crania recently received from this island resemble more those of

[1] See Zuckerkandl's Report in Reise der Novara, Anthropologischer Theil. The one which he has measured has a cephalic index 73·4.

[2] See Schaaffhausen's measurements in Supplement to *Archiv f. Anthrop.*, Bd. xiv. The mean cephalic index of the six specimens is 70·4; the mean vertical index 76·2.

[3] *Bull. and Mém. Soc. Anthrop. Paris*, t. i. of each.

[4] *Revue d'Anthropologie*, t. i. p. 250, 1872.

[5] Crania Ethnica, p. 284.

[6] Thesaurus, p. 308, Nos. 682–84.

the Polynesians than those of the Papuans, and they refer to a tradition that some generations ago a small colony of Polynesians settled there.

The *Loyalty Islands* lie a little to the west of New Caledonia. They are for the most part inhabited by Melanesians, though Polynesians have settled there. The Rev. G. Turner says that the people resemble the Fijians. Four crania from the island Maré occur in museums—a female in the Barnard Davis collection, a female in the Museum of the Anthropological Society of Paris, and a male adult and a child in the Anatomical Museum of the University of Edinburgh.[1] These skulls are all markedly dolichocephalic, the mean breadth index is 69, and this dolichocephalic character is quite as strong in the child's skull as in those of the adults. In all the specimens the vertical index was very decidedly above the cephalic.

As no male skull from Maré has yet been described, I shall state briefly the chief characters of my specimen. Its length, narrowness, and relative height are well seen from the measures in Table XVII. The temporal fossa was remarkably elongated, its antero-posterior diameter being 138 mm., and its vertical diameter 88 mm.; this was largely due to the great antero-posterior growth of the parietal bone, the longitudinal arc of which was 150 mm., and even in the child's skull the corresponding arc of that bone was 142 mm. The gnathic index was 103, or just within the prognathic group. The nasal index was mesorhine, the orbital index mesoseme, and the palato-maxillary index dolichuranic. The antero-posterior diameter of the ascending ramus of the lower jaw was very marked, and that of its coronoid process was equally so, obviously in correlation with the great breadth of the temporal muscle. The sigmoid notch was relatively shallow, and there was no disproportion between the coronoid and condyloid height: the chin was almost vertical; the gonio-symphysial length considerably exceeded the intergonial width. Each pterion had a large epipteric bone: small Wormians were in the lambdoidal suture. Indications of an infraorbital suture were on the left side, and the remains of the frontal suture were seen in the glabella.

Many more crania have been obtained from Lifu: two are in the Barnard Davis collection, four in that of the Museum of the Royal College of Surgeons, and twenty-nine in museums in Caen and Paris. The mean measurements of these twenty-nine skulls are given by MM. de Quatrefages and Hamy in their twenty-seventh table. The mean breadth index of eighteen males is 69·8, the height index 73·5; the breadth index of eleven females is 71·8, the height index 74·5. As the measurements of individual skulls are not given, one cannot gather what the maximum indices were in this series, but from Prof. Flower's measurements of the skulls in the Royal College of Surgeons it is clear that Lifu crania may attain a breadth index approaching the brachycephalic, two adults being respectively 78·3 and 78·9, and a child 80·6. Ouvea is said to have been colonised

[1] I am indebted for these specimens to my friend Dr. J. C. Cox of Sydney. Their measurements are recorded in Table XVII.

by Polynesians who migrated there some generations ago, but the three crania in the Natural History Museum in Paris from this island are said by MM. de Quatrefages and Hamy to be strongly Papuan in character, and to have a mean breadth index 68·2 and a mean height index 71·9.

The *New Hebrides, Banks's Islands*, and the *Santa Cruz Islands* form a very extensive archipelago to the north of New Caledonia and the Loyalty Islands. They are inhabited by people varying in stature, physiognomy, and colour of skin; some having strong Papuan characters, but others presenting modifications which point to an intermixture of races. The Rev. George Turner describes the men of Tanna as having less of the negro cast of countenance than some of the other Papuans, but their hair is frizzled; the Erro-

TABLE XVII.—SOUTH SEA ISLANDERS.

	Collection,	Loyalty Islands.		New Hebrides, Erromanga.				Mallicollo.	Solomon Islands. Rubiana.		Ellice group. Hudson Island.
		Maré.	Maré.	F.C.C. Kowiowi.	F.C.C. No. 2.	F.C.C. No. 3.	Dr. H.	E.U. A.M.	E.U. A.M. Head.	E.U. A.M. Head.	F.C.C.
	Age,	Adult.	10.	Aged.	Ad.	Ad.	Ad.	Ad.	...	...	Aged.
	Sex,	M.	F.?	M.	M.	M.	M.?	M.	...	...	F.
	Cubic capacity,	1556	1400	1425	...	...	...	1378	...	...	...
	Glabello-occipital length,	193	181	194	184	194	183	175	180*ap*	188*ap*	188
	Ophryo-occipital ,,	189	181	192	181	187	182	173	...	...	187
	Basi-bregmatic height,	139	133	138	138	...	136	142	...	...	141
	Vertical Index,	*72*	*73·5*	*71*	*75*	...	*74·3*	*81*	...	...	*75*
	Minimum frontal diameter,	93	92	102	98	100	100	100	...	...	100
	Stephanic ,,	105	106	108	114	124	110	114	...	...	116
	Asterionic ,,	112	105	110	...	...	108	114	...	...	115
	Greatest parietal breadth,	132*s*	126*p*	136*s*	132	152*s*	132*p*	132*s*	130	132	144*p*
	Cephalic Index,	*68·4*	*69·6*	*70*	*72*	*78*	*72*	*75·4*	*72*	*70*	*76·6*
	Horizontal circumference,	529	495	560	...	544	512	498	...	...	533
	Frontal longitudinal arc,	127	128	122	133	138	121	123	...	...	134
	Parietal ,, ,,	150	142	138	136	127	138	130	...	...	134
	Occipital ,, ,,	122	108	120	106	...	114	110	...	...	132
	Total ,, ,,	399	378	380	375	...	373	363	...	...	400
	Vertical transverse arc,	303	290	302	...	...	305	312	...	...	332
	Length of foramen magnum,	35	35	36	35	...	34	34	...	...	32
	Basi-nasal length,	103	94	110	104	...	104	108	...	...	104
	Basi-alveolar length,	106	96	106	...	...	103	116	...	...	...
	Gnathic Index,	*103*	*102*	*96ap*	...	...	*99*	*107*	...	...	..
	Interzygomatic breadth,	132	114	137	...	...	...	136	...	...	134
	Intermalar ,,	115	102	120	126	116	...	124	...	...	124
	Ophryo-alveolar length,	85	81	85	...	90	84	81	...	...	...
	Naso-alveolar ,,	66	58	65	...	65	66	65	...	...	...
	Facial Index,	*64*	*71*	*62*	...	...	...	*59*	...	...	...
	Nasal height,	49	45	53	...	48	47	47	...	...	50
	Nasal width,	24	22	28	28	24	25	25	...	...	...
	Nasal Index,	*49*	*49*	*53*	...	*50*	*53*	*53*	...	...	...
	Orbital width,	38	33	42	40	38	39	40	...	...	41
	Orbital height,	34	34	34	30	32	34	29	...	...	33
	Orbital Index,	*89*	*103*	*83*	*75*	*84*	*87*	*72·5*	...	...	*80*
	Palato-maxillary length,	59	51	59	...	...	59	64	...	...	50
	Palato-maxillary breadth,	63	59	...	67	60	63	67	...	...	64
	Palato-maxillary Index,	*107*	*115*	...	...	...	*107*	*108*	...	...	*128*
Lower Jaw.	Symphysial height	33	25	...	...	...	33	30	...	...	...
Lower Jaw.	Coronoid ,,	67	57	...	...	...	81	66	...	...	...
Lower Jaw.	Condyloid ,,	63	52	...	...	...	76	60	...	...	...
Lower Jaw.	Gonio-symphysial length,	101	87	...	...	...	89	101	...	...	...
Lower Jaw.	Intergonial width,	95	71	...	...	...	99	88	...	...	...
Lower Jaw.	Breadth of ascending ramus,	45	40	...	...	...	36	46	...	..	...

mangans are a kindred race to the Tannese; a Samoan colony had settled on the island Faté. Up to this time two crania only, from Erromanga, the largest of the southern New Hebrides, have been described, both in the Barnard Davis collection. I have had the fortune to examine four additional specimens from that island, three in the Museum of the Free Church College, Edinburgh,[1] and one from the collection of the late Dr. Handyside, now in the Edinburgh University Anatomical Museum. Their measurements are given in Table XVII. Three of these crania were decidedly dolichocephalic, like those in the Barnard Davis collection, and in each specimen the vertical index exceeded the cephalic. The gnathic index was mesognathous, the nasal index mesorhine, the orbital index microseme. The male skull, Kowiowi, may be taken as typical of these dolichocephalic Erromangans. It was beyond the adult stage, as the sockets of the majority of the teeth were absorbed. It was very massive, for without the lower jaw it weighed 1 lb. 14½ oz. avoir. The glabella, supraciliary and occipital ridges were projecting, and the temporal ridges were double. The antero-posterior diameter of the temporal fossa was 132 mm., and its depth 96 mm. The vertex was roof-shaped. In this and the other Erromangans the frontal diameters were greater than in the Loyalty Islanders. The skull from the Handyside collection was the only one with a lower jaw; the chin was massive and projected forwards, the antero-posterior diameter of the ramus was much less than in the Loyalty Islanders, the coronoid was pointed and with a narrow base, the sigmoid notch was deep, and the gonio-symphysial length was much less than the intergonial width. This skull had also a remarkably long vaginal process ensheathing the styloid. The fourth skull, No. 3 in the Free Church College Museum, had a cephalic index 78, and approached therefore brachycephalic proportions. It belonged obviously to a different type from the others; it was not ridge-like on the summit but well filled, so that the cranial vault was relatively flattened, and the norma verticalis was rounded. The glabella was projecting. There was no evidence of artificial flattening either in the frontal or occipital regions.

Three crania from Tanna are in the Barnard Davis collection and one in the Museum of the Royal College of Surgeons. Their respective cephalic and vertical indices are C.I. 85, V.I. 83; 77, 85; 72, 72; 75, 75.[2] The Barnard Davis collection also contains a skull from Aneitum, C.I. 68, V.I. 73. The Museum of the Royal College of Surgeons has a skull from Ambrym, C.I. 70·2, V.I. 75·1; one from Cherry Island, C.I. 77·7,

[1] I am indebted to Prof. Duns, D.D., for the opportunity of studying these crania, as well as the one from Hudson Island, Ellice group, in the same museum, referred to on p. 103. One of the three Erromangan skulls is especially interesting. It is that of Kowiowi, the leading actor in clubbing to death the Rev. John Williams. Kowiowi was under chief at Bunker on Dillons Bay at the time of the murder in November 1839. Accompanying the skull was a letter to Dr. Duns from the donor stating how and by whom the skull was obtained. The Erromangan skull from Dr. Handyside's collection is also said to have belonged to one of the men who killed Williams. This skull has, however, some feminine characters, which make its sex doubtful. A slice had been taken out of the parietal bone as if with a tomahawk.

[2] For further measurements and indices see the Thesaurus Craniorum and Prof. Flower's Catalogue so often cited.

V.I. 86·9; two from Banks's Islands, C.I. 73·3, V.I. 73·3; C.I. 80, V.I. 78·8. In the same museum are two from Api, and in the Barnard Davis collection is one from the same island, the indices of which are C.I. 73·8, V.I. 73·3; C.I. 77·5, V.I. 81·1; C.I. 66, V.I. 76. Ten crania from Faté are in the Barnard Davis, College of Surgeons, and Paris Museums. MM. de Quatrefages and Hamy give the mean C.I. of five males as 68·4, the V.I. 73·6; the C.I. of one female 20·2, the V.I. 77·7. The Barnard Davis specimens are respectively C.I. 65, 69, 80; V.I. 75, 77, 77. Three skulls from Vanikoro have been carefully described, and one of them figured by Mr. G. Busk.[1] The cephalic indices are respectively 70·4, 71, 71, and the vertical indices 80, 84·4, 82·6. The height of these skulls is, as Mr. Busk points out, very remarkable. The gnathic index is not as a rule very pronounced. Mr. Busk also recognises the general preponderance in length of the parietal longitudinal arc over the frontal.

From the observations of MM. Quoy and Gaimard on the "Astrolabe"[2] and of those of M. P. A. Lesson, the people of Vanikoro are Papuans, though Lesson states[3] that they are more or less mixed with a yellow Polynesian race. A single skull from the island of Espiritu Santo is in the Godeffroy Museum. Krause gives the length 184 mm., breadth 138, height 139; the cephalic index is 75, the vertical index 75·5.

Much light has of late years been thrown on the skulls of the people of Mallicollo, one of the northern New Hebrides. The collection of eight crania in the Museum of the Royal College of Surgeons described by Mr. Busk,[4] the series of monumental heads and deformed skulls in the same museum described by Prof. Flower,[5] and the sixteen crania in the Godeffroy Museum of which Dr. Krause has given an account,[6] have supplied interesting material for study. The people of this island are distinctly Papuan in their external characters, but amongst them the practice of artificially deforming the head by pressure applied to the frontal region during infancy extensively prevails. This practice of course affects the measurements, but when allowance is made for the change in form produced by pressure, the skulls are without doubt dolichocephalic. In Mr. Busk's series the breadth index varied from 68 to 74, and four of the skulls were below 70. The height index in each skull was with one exception above the breadth index. The mean length of the skulls in the Godeffroy Museum was 181·8 mm., the maximum 195, the minimum 164; the mean breadth was 127 mm., maximum 135, minimum 122; the mean height was 138 mm., maximum 147, minimum 125. The mean indices were as follows—C.I. 69·8, V.I. 76. In the Anatomical Museum of the University of Edinburgh is a skull marked "Mallicollese," which was purchased many years ago from a sailor by the late Prof. Goodsir. It showed no flattening in the frontal region, but had been markedly flattened and rendered unsymmetrical behind by pressure in the parieto-occipital region. The

[1] *Journ. Anthrop. Inst.*, vol. vi. p. 200, 1877.
[2] Voyage de l'Astrolabe, Hist. vol. v.
[3] *Revue d'Anthropologie*, t. v. p. 257, 1876.
[4] *Journ. Anthrop. Inst.*, vol. vi. p. 200, 1877
[5] *Journ. Anthrop. Inst.*, vol. xi., 1881.
[6] *Op. cit.*, p. 616.

highest part of the skull was about midway between the bregma and obelion, and the height from the plane of the foramen magnum to the summit was 5·4 inches. The antero-posterior diameter of the temporal fossa was 117 mm., being materially below that of the Erromangans or Loyalty Islanders. The measurements are given in Table XVII.; C.I. 75·4, V.I. 81. Prognathism was very marked and the palato-maxillary region was one of the longest that I have measured. Traces of the frontal suture extended through the glabella into the ophryon. A large epipteric bone existed on each side; Wormian bones were in the lambdoidal suture, and a suture passed from the infraorbital foramen into the floor of the orbit. The antero-posterior and transverse diameters of the foramen magnum were equal. The lower jaw had a wide ramus, a broad-based coronoid process, and a shallow sigmoid notch. From Prof. Flower's description and figures it is evident that the artificial flattening of the head in the Mallicollese is not limited to the frontal region, but that in some cases pressure is applied to the back of the head. This is corroborated by the specimen I have now described.

The *Fiji Archipelago* forms the north-eastern group of islands of the Melanesian region. They are inhabited by a race possessing well-marked Papuan characters, but colonies of the brown Polynesians from Samoa and Tonga have established themselves in many of these islands, especially on the sea-coast.[1] The best collections of skulls from Fiji are in the Godeffroy Museum, which possesses seventy-four crania; the Museum of the Royal College of Surgeons, with twenty-four specimens; the Natural History Museum in Paris, with fifteen specimens; and the Barnard Davis collection, with ten specimens. Other museums also contain individual crania.

A skull of brachycephalic proportions, cephalic index 84·2, from the Fijian island Moutouata is in the Army Museum of the United States.[2] A few mesaticephalic crania from the islands Mango, Vanua Balavu, Vakaia, Moturiki, Kandavu, Dzizia, and Ovalau, varying in their cephalic indices from 75·1 to 79·2, have been recorded by Barnard Davis, Flower, Krause, de Quatrefages with Hamy and Rabl-Rückhard; but skulls of these proportions are quite exceptional. The great majority of the Fijian skulls which have been measured are dolichocephalic, and as a rule so long and narrow that the term stenocephalic has been applied to them. A most careful description, with figures, of a series of sixteen crania of the Kai Colos, or natives of the mountains of the interior of Viti-Levu, has been given by Prof. Flower.[3] The breadth index was in each skull below 70, and the height index in each specimen was markedly above that of the breadth. Dr. Krause gives the following numbers as the mean measures of the skulls in the Godeffroy Museum obtained from the following islands:—Viti-Levu, C.I. 67·6, V.I. 75·1; Moturiki, C.I. 68·8, V.I. 75·2; Ovalau, C.I. 69·1, V.I. 76·1. The people of Mango

[1] Die Inseln des stillen Oceans, by Prof. Meinicke; also Wallace's Australasia.

[2] Referred to by de Quatrefages and Hamy, p. 291.

[3] Cranial Characters of Natives of Fiji Islands, *Journ. Anthrop. Inst.*, vol. x., November 1880.

have a mean C.I. 73·2, V.I. 77·3; those of Oneata, C.I. 74·6, V.I. 78·8, so that, as both Flower and Krause have pointed out, the dolichocephaly diminishes in the eastern islands, *i.e.*, in those in closer proximity to the Tonga Archipelago, and a transition is established between the stenocephalic western Fijians and the brachycephalic Tongans, due without doubt to an intermixture of the two races.

From the observations of the several craniographers to whose labours I have had so frequently to refer in the course of this comparison, the conclusion has been drawn that the skulls of the Melanesians are distinctly dolichocephalic, and this conclusion has been confirmed by the additional observations recorded in this Report. But further, it has been shown that the height of the Melanesian skull exceeds its breadth, so that the vertical index is greater than the cephalic. The presence of a people in some of the islands in the Melanesian area in whom the skull is remarkably long, narrow, and high, was especially pointed out by Dr. Barnard Davis, and the skulls of this form were named by him hypsistenocephalic.[1] He describes the people of New Caledonia, the New Hebrides, the Loyalty Islands, probably the Fijians, and perhaps some of the Caroline Islanders, as possessing skulls of this form. The correspondence of the crania of the people of Vanikoro with this type was pointed out by Mr. Busk. Prof. Flower states that the skulls of the Kai Colos, or mountaineers of Fiji, belong to the most pronounced hypsistenocephalic type, and the skulls of the Loyalty Islanders described in this Report are characteristic examples.

Although both the Admiralty Islanders and the dolichocephalic people of New Guinea agree with the people named in the last paragraph in having a vertical index greater than the cephalic, yet, if one place side by side the Loyalty Islander skulls, the drawings of the Fiji mountaineers published by Prof. Flower, the New Guinea skulls from Jarvis Island, Tomara, and Possession Bay (Table XVI.), and the Admiralty Islander crania, the Fijians and Loyalty Islanders can be at once distinguished from the New Guinea and Admiralty Islanders. The Fijians, Loyalty Islanders, and New Hebrideans have larger and more massive crania than the others, and belong evidently to a people physically stronger. But the differences in the two groups can be more definitely brought out by comparing my measurements of the Admiralty Islanders with those of the Fijian mountaineers made in an almost similar manner by Prof. Flower.

The Fijian skulls are remarkably dolichocephalic, for the mean cephalic index of eleven specimens (six males, five females) is only 66, whilst that of the Admiralty Islanders is 70. This low latitudinal index, whilst showing a material difference in the relations of length and breadth in the two series of crania, yet does not express all their differential characters in these dimensions. For whilst in none of the Admiralty Islanders does the glabello-occipital diameter exceed 186 mm., and in five specimens falls below 180, in the

[1] Peculiar Crania of Inhabitants of certain groups of islands in the Western Pacific, *Natuurk. Verhand. Holland. Maats. Wetensch.*, Haarlem, vol. xxiv., 1866. See also *Anthropological Review*, vol. iv. p. 48.

shortest of the Fijian skulls (two females) it is 182, whilst six specimens (all males) are 190 or upwards. In their greatest transverse diameters the two series of skulls much more closely approximate, for whilst the average of the twelve Admiralty Islanders is 128 mm., that of the eleven Fijians is 126. The Fijian skulls are therefore not only relatively but absolutely considerably longer than the Admiralty Islanders. The crania also exhibit differences in the altitudinal or vertical index, for whilst the average height of the Admiralty Islanders is 131 mm., that of the Fijians is 140. In consequence, therefore, of this predominance in length and height, the Fijian skulls possess a considerably greater cubic capacity, the average of which in the males is 1504 c.c., in the female 1327 c.c., so that their female average is somewhat higher than that of the males and females collectively in the Admiralty Island series.

All the Fijian skulls are strongly phænozygous. In the Admiralty Islanders, notwithstanding the broken zygomatic arches in several specimens, the skulls are as a rule manifestly cryptozygous. In the degree of prognathism the two series of crania closely correspond, for the average gnathic index in the Admiralty Islanders is 103, and that of the Fijians is 103·7. A marked difference, however, is to be seen in the relations of the length and breadth of the nasal aperture, for whilst the breadth is more than half the height in the Fijians, in whom the average nasal index is 56·6, and all the specimens, with one exception, belonged to the platyrhine group, only four of the Admiralty Islanders are platyrhine, six are leptorhine, and the general average is on the line between the leptorhine and mesorhine groups. The mean orbital index in the Admiralty Islanders is about the middle of the mesoseme series, and alike in the two sexes; whilst in the Fijians it shows a marked difference in the males and females. For in the males it is on the average 84·2, or barely within the mesoseme series, whilst in the females it is 90·7, or distinctly megaseme. In the form of the palato-maxillary region the two series of skulls are much alike, for the mean palato-maxillary index in the Admiralty Islanders is 112, and in the Fijians it is 111, so that they are both mesuranic.

In conclusion, whilst both series are markedly dolichocephalic, the latitudinal index is much lower, the altitudinal index is much higher, and the cranial capacity is greater in the Fijians than in the Admiralty Islanders; the Fijians are phænozygous, platyrhine, mesoseme in the males and megaseme in the females; the Admiralty Islanders are, as a rule, cryptozygous, lepto-mesorhine, and mesoseme. The two series of crania, however, closely correspond in the degree of prognathism and in the form of the palato-maxillary region.

The question therefore arises, are the people with hypsistenocephalic crania to be regarded as a different race from the other dolichocephalic people inhabiting the Melanesian region? Dr. Barnard Davis is evidently inclined to the opinion that they are a different race, but this opinion is not shared by ethnologists generally. Neither does the evidence which has been advanced in its support seem to me to be conclusive. For, as Dr. Davis himself admits, crania in which hypsistenocephalism exists do not all exhibit

it in the same degree. Crania pass by almost insensible gradations from the extreme form seen in Fiji or the Loyalty Islands to skulls which are of the New Guinea or Admiralty Island conformation. The hypsistenocephalic character seems to be an exaggeration of the Melanesian type, fostered perhaps by tribal interbreeding and hereditary descent amongst those who inhabit the mountainous regions, and those who have had little communication with the people of adjacent islands; whilst in the inhabitants of the sea-coast, more liable to intermixture, the type form has not assumed such exaggerated proportions, or perhaps has become altered by mingling with other races.

We may now pass to the consideration of the area occupied by the Mahori or brown Polynesian race. Ethnologists generally look to the Samoan and Tonga Islands as the central home of this race in the Pacific, from which it has diffused itself in several directions.[1]

The *Tonga Islanders,* so far as their skulls have been examined, are almost purely brachycephalic. Three adults measured by Prof. Flower are distinctly so, and six adults in the Godeffroy Museum, measured by Dr. Krause, are wholly so, with one exception, and that is mesaticephalic. The mean of the eight brachycephali is 84·5, and the range is from 80 to 89·4. Some children's skulls from the Tonga Islands have a cephalic index of 90·6 and 92·9. Krause states that the skulls of the Tonga Islanders have a high, steep, broad forehead, flat and deeply descending occiput, parietal tubera laterally projecting, broad face, large eyes and little prognathism.

The *Samoan Islanders* are not so uniformly brachycephalic. Two crania in the Museum of the Royal College of Surgeons are undoubtedly so, C.I. 80·6 and 89; but only three out of thirteen skulls, mostly from Upolu, in the Godeffroy Museum have a cephalic index above 80; four are below 75, whilst six are mesaticephalic; but of those, five are above 77, so that they approach the brachycephalic standard. It would look therefore as if a certain Melanesian admixture with the Polynesian people had taken place in Upolu. The vertical index in the Samoan dolichocephali was as in the Melanesian race distinctly higher than the cephalic. Whereas in the brachycephali the vertical index, though occasionally above the cephalic, as a rule was not so, and in some instances was markedly below it. Krause gives the cephalic index of a skull from the small island Futuna as 87, and Flower that of a native of Savage Island(Niuë), lying midway between the Tonga and Samoan groups, as 83·8. The Rev. G. Turner states that Savage Island is populated by light copper coloured natives very like the Samoans, and that their dialect is a mixture of Samoan and Tongan; but Mr. W. L. Ranken, although recognising their Samoan affinities, considers that there is also an intermixture of Papuan traits.

Crania of the *Ellice Islanders,* to the north-west of the Samoan Islands, are very

[1] See the accounts of the Samoans by the Rev. S. Whitmee (*Contemporary Review*, February 1873); Mr. Pritchard and Mr. W. L. Ranken in *Journ. Anthrop. Inst.*, vol. vi. p. 224, and Rev. G. Turner in "Samoa," London, 1884.

sparingly represented in our museums. Prof. Flower gives the cephalic indices of two specimens from Nanumea as 81·2 and 77·5, and their vertical indices 76·8 and 75·3. Dr. Krause has measured one from Niutao, with C.I. 83·2, and V.I. 76·5. In Table XVII. I have given the measurements of a skull in the Museum of the Free Church College from Hudson's Island in the Ellice group. This skull was apparently that of a woman well advanced in years, for the sutures of the cranial vault were almost obliterated. The cephalic index was 76·6 and the vertical index was only 75. In its configuration this skull closely resembled the mesaticephalic Erromangan described on p. 97, and like it was probably a cross between a Melanesian and a Mahori. The breadth of the palate greatly preponderated over the length, so that the palato-maxillary index was unusually high. The Rev. G. Turner says,[1] that tradition traces the origin of the people of Hudson's and the other islands of the Ellice group to Samoa.

Hervey's or Cook's Islands have apparently contributed only two skulls to museums. The one from Mungaia in the Barnard Davis collection is distinctly dolichocephalic, and has C.I. 70, V.I. 76; the other from Rarotonga, in the Godeffroy Museum, has very different proportions, and is very brachycephalic, C.I. 86·4, V.I. 79; Krause also states that it is strongly prognathic. This difference in the cranial proportions is in accordance with what has been said as to the physical characters of the people of these two islands. For Rarotonga "is inhabited by people who have legends of their migration from Samoa and speak a closely allied language;" whilst in Mungaia the "Melanesian type predominates, the people being dark brown, with wavy or frizzled hair and well bearded."[2]

The *Society Islands* are represented by at least thirty crania, twenty-three of which are in the Natural History Museum, Paris, and the remainder in the Godeffroy Museum, the Barnard Davis collection, the "Novara" collection and the Museum of the Royal College of Surgeons. The mean cephalic index of these series of skulls is 77; the maximum being 79·6, a skull from Tahiti; and the minimum 74, a skull from Raiatea. The vertical index in these specimens is as a rule higher than the cephalic. Tradition points to these islands as having been settled from Samoa.

The *Low or Paumotu Archipelago*, to the immediate south-east of the Society Islands, has contributed a number of crania, the majority of which are in the Paris Museum. MM. de Quatrefages and Hamy state that these islanders have crania which are generally like those of the Society Islanders, but they do not record any measurements. Dr. Krause gives the measurements of two specimens from Tipoto and Niau in the Godeffroy Museum, the cephalic index of one is 76, that of the other 76·3. Another specimen from Bligh Island is described by Zuckerkandl,[3] who places the breadth index at 70·8. He says that the specimen is stenocephalic, and differs from the skulls of other Polynesians

[1] Samoa, pp. 288, 293, London, 1884.
[2] W. L. Ranken in *Journ. Anthrop. Inst.*, vol. vi., 1877, and Wallace, Australasia, p. 507.
[3] Reise der Novara, Anthropologischer Theil, p. 111, 1875.

to which he has had access. The skull of a Gambier Islander, one of the southern islands of this archipelago, in the Barnard Davis collection, has a cephalic index 72 and a vertical index 79. Mr. Ranken states that the natives in the Paumotus show some evidence of a people having been there prior to the Mahori occupation, and that they have a number of words not traceable to any Mahori dialect.

Crania of the *Marquesas Islanders* are abundant in the Barnard Davis collection and in the Paris Museum, the Godeffroy Museum also contains four examples. Of the thirty-six specimens in the Barnard Davis collection fourteen had a cephalic index of 80 or upwards, fifteen were from 75 to 80, and seven were below 75. In the brachycephali the vertical index was as a rule below the cephalic, in the dolichocephali it was as a rule above it, whilst in the mesaticephali it was sometimes above, at others below. Of the four specimens in the Godeffroy Museum, one was brachycephalic and three were mesaticephalic. MM. de Quatrefages and Hamy do not give the measurements of the individual crania in the Paris Museum, but they place the mean of twelve crania of the Teïs from the environs of Fort Collet at 79·4, whilst eight crania from Tahou-Ata have a mean cephalic index of 75·3. It is obvious therefore that a considerable diversity exists in the cranial proportions of the natives of this group as well as in the separate islands. Thus the skulls from Nuka-hiva in the Barnard Davis collection varied in the cephalic index from 69 to 83; those from Fatu-hiva varied from 70 to 86; those from Ohivaoa from 74 to 84; and those from Uahuga from 76 to 82. The series from each of these islands, therefore, excepting the last, contained skulls possessing dolichocephalic, mesaticephalic, and brachycephalic proportions. Two crania from Nuka-hiva were also collected by the "Novara";[1] the one had a cephalic index 73·5, the other 79·5.[2] Tradition points to the colonisation of these islands from the Samoan group.

The *Sandwich Islanders* present great diversities in the proportions of the crania, as I have already pointed out in a previous section of this Report (p. 62, *et seq.*), so that the thirty-six adult crania varied in the cephalic index from 71 to 86; and of these ten were upwards of 80, eleven were from 75 to 79 both inclusive, and fifteen were below 75. As it happened the four skulls from Hawaii were all brachycephalic, but the thirty-two from Oahu presented examples of each of the three divisions of the length-breadth index.[3] My measurements of the skulls from Oahu are generally in accordance with those made by Dr. Barnard Davis on a still larger collection from that island presented to him by W. L. Green, Esq. A reference to the measures recorded in the Thesaurus Craniorum will show that his collection of upwards of one hundred skulls varied in the cephalic index from 69

[1] See Zuckerkandl's description, and pls. xvi., xvii., and xx.

[2] Blumenbach has also figured a Marquesan cranium. Plate L. Decas quinta.

[3] A description of the burying ground at Waimanalo, Oahu, from which Mr. Moseley obtained the skulls described in this Report (p. 62), has also been given by Dr. Finsch, *Zeitschr. für Ethnol.*, Bd. xi. p. 326, 1879. Dr. Finsch considers that the skeletons found there are pure Hawaians, belonging to a period free from European influence, as this part of the coast has not been disturbed by white people.

to 90. Sixty specimens had a cephalic index of 80 or upwards; twelve were below 75, and the remainder were from 75 to 79 both inclusive; the brachycephali were, however, present in a larger proportion than in my series from the same island. Six skulls from Hawaii in the same collection varied in the cephalic index from 72 to 86, and of these, four were 81 or upwards. Dr. Davis gives the mean C.I. of the entire series of Sandwich Islanders in his collection as 79 for the men and 80 for the women. Of the four skulls from Hawaii in the Museum of the College of Surgeons, two had the cephalic index 81·7, 85·7; the other two were 69·5 and 71·8. MM. de Quatrefages and Hamy give the mean cephalic index of fifteen male Sandwich Islanders as 75·5 and of seven females as 78·4. They also refer to a large collection from the islands Maui and Kauai measured by M. Otis, the mean breadth index of ninety-seven men being 81·3, and of forty-one women being 80·5. As the measurements of the individual skulls are not given by these last named craniologists, I am not able to say what is the range of variation in their respective series. It is well known that the practice of artificially flattening the back of the head prevailed to some extent amongst the Sandwich Islanders, and I agree with MM. de Quatrefages and Hamy that this will necessarily have the effect of somewhat raising the cephalic index of the skulls in which this deformation exists. In my series of skulls the relation of the vertical to the cephalic index varied with the cephalic index. In the brachycephali and almost all the mesaticephali the vertical index was less than the cephalic, whilst in a considerable number of the dolichocephali the vertical index exceeded the cephalic. The former therefore corresponded in this relation with the Polynesian, the latter with the Melanesian character.

Retzius, from the study of a Sandwich Island skull in his collection, and of a number of Polynesian skulls which he saw in London, came to the conclusion that they were one of the highest members of his brachycephalic prognathic class, and formed a transition from this to the dolichocephalic.[1] Dr. Uhde has also described four crania from Oahu,[2] three of which came from a battlefield on the plain of Kulau, and one from the neighbourhood of Diamonds-hill on the south-east coast. He recognises such differences between them as to place two in Retzius's *dolichocephalæ prognathæ* and two in his *brachycephalæ prognathæ*.

There is thus abundant evidence to show that the crania of the Sandwich Islanders are by no means homogeneous in their characters, but present wide differences in form and proportions, and in this respect they agree with the Marquesas Islanders. To what are these differences to be ascribed? The most rational conclusion I think will be that they express the presence in these islands of more than one race of men. Captain Cook refers to the fine physique of the chiefs and their superiority to the natives generally.

[1] Ethnologische Schriften, p. 65; and *Müller's Archiv, Anat. u. Physiol.* 1874.

[2] *Nova Acta Acad. Nat. Cur.*, vol. xxviii., 1861.

M. Choris also speaks[1] of these differences between the chiefs and the common people, and further points out that in some the hair is crisp or frizzled, approaching to a woolly appearance, in others it is soft and flexible; the skin also differs in colour from yellow to a rich brown. Dr. Bielitz, quoted by Uhde, also states that the chiefs of the Sandwich Islands differ remarkably in size, strength, colour, &c., from the common men, which led him to conclude that two different races existed there. There is thus a concurrence of opinion amongst travellers of such differences in the external characters of the people as would point to the presence of both a Polynesian and a Melanesian element, and these differences are supported by their craniology. Where but little intermarriage had taken place between the two races, each would preserve its purity of type, but with an intermixture then the two races would be more or less fused with each other. The traditions of the Sandwich Islanders point to Tahiti the largest of the Society Islands as the place from which they came, and it is not unlikely that these Polynesian adventurers when they landed on Oahu and the other Sandwich Islands found a Melanesian people living there.

New Zealand, with its outlying dependency the *Chatham Islands*, has been generally regarded as inhabited by the Polynesian race. Owing to the English colonization numerous crania have been collected, more especially from New Zealand, and are now in museums.

The measurements of fourteen skulls from the Chatham Islands in the Barnard Davis, College of Surgeons, Godeffroy, and Paris Museums, and in the collection formed by the "Novara," have been published, and to these may now be added the nine skulls described in this Report. The cephalic index varied greatly in this series of twenty-three skulls. If I exclude the child's skull, measured by Barnard Davis with an index of 89, the crania varied from 72 to 83, and presented examples of dolichocephalic, mesaticephalic, and brachycephalic crania; two were 80 or upwards, four were below 75, and sixteen were from 75 to 79 both inclusive, the preponderance therefore being decidedly in favour of those with intermediate proportions. The mean cephalic index of the series was 76. In the few skulls with a high cephalic index the height was less than the breadth, but it is also to be noticed that even in the skulls with a low breadth index, the vertical index was as a rule below the cephalic. The crania also were not prognathic, and although the average of Prof. Flower's series of five skulls was somewhat above mine, yet his are only mesognathous. De Quatrefages and Hamy refer to the cubic capacity of the crania of the Chatham Islander men as being exceptionally large, but this was not the case in my specimens, in which the mean of the series was the same as that of the New Zealanders.

The New Zealand crania are much more numerous in museums than the Chatham Islanders. In addition to the twenty-one specimens described in this Report, the Barnard

[1] Quoted by Prichard in *Natural History of Man*, vol. ii., p. 440.

Davis collection contains nine specimens, the Museum of the College of Surgeons at least thirty, the Natural History Museum in Paris possesses upwards of thirty skulls, the Godeffroy Museum three; eight are described in the account of the "Novara" Expedition,[1] whilst individual specimens are in the Berlin and other museums. MM. de Quatrefages and Hamy do not give the measurements of the individual skulls in the Paris Museum, but only the average; they place the cephalic index of fifteen men at 73·26, that of fifteen women at 72. More detailed measurements of seventy-two specimens are, however, given by Barnard Davis, Flower, Zuckerkandl, Krause, Rabl-Rückhard, and myself, from which I gather that only five specimens had a cephalic index of 80 or upwards; forty-one were below 75, and twenty-six between 75 and 79 both inclusive. The mean breadth index of the entire series was 74. The New Zealanders therefore incline to dolichocephalism, and at least four are recorded with a breadth index below 70.[2] Not unfrequently in the skulls with the lower cephalic index the vertical index exceeded the cephalic, but there were so many exceptions that it cannot be regarded as the rule in them for the basi-bregmatic height to exceed the greatest breadth. The crania are not characterised by any marked projection of the upper jaw. The mean of my series, as already stated, was orthognathic, the mean of Prof. Flower's measurements places his series of skulls on the verge between orthognathism and mesognathism.

The traditions of the New Zealanders, the study of their language by several philologists,[3] and the observations on their external characters by Captain Cook and other voyagers have all combined to the conclusion that the Maoris are an offset of the great Polynesian race, and their traditions point to Samoa as the group of islands from which they had sprung. If this view of their origin be correct, then we should expect that their cranial characters would correspond with those of the people from whom they had originated. It is of course impossible to state with any precision at what date they had separated from their parent stock and settled in New Zealand, but this must have happened a number of centuries ago. We have already seen that the Polynesians living in the islands nearer to the equator, although they possess a large percentage of brachycephalic heads, yet have intermingled with them skulls of mesaticephalic and dolichocephalic proportions. To some extent this is doubtless in part due to comparatively recent intermixtures of the Melanesian and Polynesian races. But if, as I shall attempt to show immediately (p. 110), a Melanesian people had inhabited Polynesia prior to its colonisation by the yellow brown race, and had to some extent fused with it, then the New Zealand colonists would not have been pure Polynesians, but would have had a

[1] Zuckerkandl, *op. cit.*

[2] The remarkably elongated skull in the Museum of the College of Surgeons, with an index of only 62·9, described by Prof. Huxley in his paper on two widely contrasted skulls (*Journ. Anat. and Phys.*, vol. i. p. 60, 1867), and which he thought might be a New Zealander, is now regarded by Prof. Flower (New Cat., p. 216) as more probably from the New Hebrides. It is not included in the above summary.

[3] *The Transactions of the New Zealand Institute* contain many valuable and instructive papers on the origin of the Maoris.

certain admixture of Melanesian blood. But, on the hypothesis of a general diffusion of the Melanesian stock over the Pacific Islands, it is possible that New Zealand may have been inhabited by people of that stock prior to the Polynesian invasion, and in consequence a still further dilution of the Polynesian characters, either in particular localities or pretty generally throughout the island, may have taken place by interbreeding between the two races.

In support of this hypothesis I may refer to the accounts which have been given of the external appearance of the Maoris, from which it is clear that considerable differences have been observed in their hair and features. The skin varies in colour from a clear olive brown to an opaque black-brown. The hair is brown, or black, or even reddish, and straight or curly; the beard is often well-grown and bushy.[1] The features are sometimes coarse, with thick lips and broad noses, at others much more delicately moulded. Their crania also exhibited many variations from the Polynesian type. As already stated (p. 107), but a small percentage were brachycephalic, whilst a large proportion were dolichocephalic, and the mean cephalic index of the series of seventy-two skulls was 74, which places them just below the mesaticephalic minimum. It is clear therefore that there is a strong tendency in the skulls of this people to assume dolichocephalic proportions, and thus to depart from a pure Polynesian type, much more strongly than is the case with the Samoans, the Marquesas Islanders, or even the Sandwich Islanders. It would be interesting to inquire whether marked differences exist in the form of the skull in different districts, and whether there are equally marked variations in skulls from the same district. Unfortunately the collection on which I have reported does not enable me to go very completely into such an inquiry, but I may point out that the six crania from Kapiti Island, all apparently from one tribe, varied in the cephalic index from 67 to 78 amongst the adults, and in a child rose to 82, whilst the vertical index varied from 69 to 76, and that considerable differences existed in the nasal, orbital, and palato-maxillary indices.[2] The skulls from near Auckland also varied in their cephalic index, so that it would seem as though considerable differences in this respect may occur in people of one and the same tribe.[3] The conclusion therefore to which I have come from the consideration of these

[1] In the Anatomical Museum of the University of Edinburgh are four tattooed and preserved heads of New Zealanders. In one the hair was jet black, long, closely set, thick and wavy. This man also had a short-clipped thin moustache and a moderate beard, the hairs of both of which were brown and brownish-black. In the second the hair was long, black and straight. He had a short thin brown moustache and a tuft of hair at the chin. In a third the hair was reddish-brown and straight, long at the back and short at the front of the head. In the fourth the hair was brown-black, and arranged in spiral tufts, the hairs of which, when straightened out, were five or six inches long. These tufts were separated from each other by intermediate portions of scalp, from which the hair had been cut quite close to the skin. The tufts were therefore isolated from each other by the cutting away of the intermediate patches of hair.

[2] MM. de Quatrefages and Hamy give the mean measurements of two adult male crania from Kapiti, which yield the following indices:—Cephalic index, 76·3; vertical index, 75·1.

[3] In the description of the New Zealand crania in the earlier part of the Report (p. 77), I have omitted to state that in the skull from Marlborough the temporal ridge mounted in a remarkable manner to near the vertex, so that on the left side its summit was only 20 mm., and on the right side 22 mm. from the sagittal suture.

various facts is that the study of the crania supports the view that New Zealand had been occupied by a dolichocephalic and probably Melanesian race, before the Polynesian element was introduced into it.

The origin of the Chatham Islanders is shrouded in mystery. The massacre of so large a portion of these islanders by the Maoris before Europeans had become well acquainted with them, has interfered with our obtaining much information on their traditions. It is believed, however, that the Morioris are the result of an intermixture of Polynesians with Melanesians. It is said that they are shorter and stouter than the Maoris, darker in the skin, with lank black hair, aquiline noses, and a Jewish cast of countenance,[1] and that they can be readily distinguished from the Maoris. From the description of their crania in the earlier part of this Report (p. 73), it will be seen that they are in the lower term of the mesaticephalic series, and that the vertical index is less than the cephalic. Their breadth index was somewhat higher than the New Zealanders, and their nasal index was somewhat lower, but in other respects the proportions of parts in the two series of crania closely corresponded. The slope downwards and outwards from the sagittal suture to the parietal eminences, and the vertical direction of the wall of the skull below the parietal eminence, gave to the New Zealand skull, though in a less degree, that pentagonal outline in the norma occipitalis which has already been referred to (p. 73) as so marked in the Chatham Islanders. The characters of the skulls of the Morioris are such as might well be referred to a mixture of the Polynesian with the Melanesian race, and it is possible that, as in New Zealand itself, the Polynesian settlers may have found this group of islands occupied by a Melanesian people, and have intermingled with them.

From this summary of the proportions of the skulls of the people occupying the Polynesian area, it would appear that there is great diversity in the relation of the length to the breadth of the cranium, so that brachycephalic, mesaticephalic, and dolichocephalic crania are found amongst them. In some localities in the Melanesian area, more especially in and near New Guinea, a similar diversity was described, though the dolichocephalic type predominated, and in such localities as the mountains of Fiji and the Admiralty Islands seemed to be the exclusive form. These modifications in the relation of length to breadth in the Melanesian area were ascribed to a mixture of other races with the prevailing Papuan stock, and the question now arises whether a mixture of some other race or races with the proper Polynesian stock has taken place so as to have caused a modification in the form of their head.

If we assume that the type form of the skull in the Polynesians is brachycephalic, then, so far as our present material for observation admits of conclusions to be drawn, we may say that the Tonga Islanders present this type in its purest form. But if we pass from these islands to the groups situated either north, south, east, or west, then along

[1] Mr. E. A. Welch's account of these people in *Anthropological Review*, vol. viii. p. ci., 1870.

with brachycephalic crania others are intermingled which have mesaticephalic and even dolichocephalic proportions. From what quarter then has the race proceeded which has given this more pronounced length to the skull? There can, I think, be little doubt that this is due to a mixture with a Melanesian element. What the relation may be as regards time when the Polynesians and Melanesians first colonised their respective islands, which in short is the older race, is of course very difficult to say, though I am inclined to think that the Melanesians have the greater antiquity. Various considerations might be advanced in support of this position. The proficiency of the Polynesians in agriculture, in native manufactures, in the art of carving, their songs and traditions, their treatment of women, their submission to the government of chiefs, and their religious observances, all point to the Polynesians as having reached a stage of civilization which places them in advance of the pure Papuans. But the fact that dolichocephalic heads are much more generally diffused throughout the Polynesian area, than are brachycephalic heads throughout the Melanesian area, points to the conclusion that the Pacific Islands generally were at some remote period inhabited by a dolichocephalic and probably Papuan race, which in several islands has been entirely replaced by the Polynesians, in others very much intermingled with them,—so that the present inhabitants are a mixed race,—whilst in others again it has retained its pristine purity. How extensive this diffusion has been is shown by the considerable proportion of dolichocephalic crania which have been procured from islands so far removed from each other as the Sandwich Islands in the North and New Zealand in the South Pacific. The people of Humphrey's Island in the Manaluki group, about 700 miles west of the Marquesas Islands, are said by the Rev. George Turner to be light brown eastern Polynesians, but the inhabitants of Penrhyn's Island, in the same archipelago, have been described by Mr W. L. Ranken[1] as tall, dark brown, with wavy hair sometimes frizzled into mops, and with prominent noses, all which characters are Papuan. Penrhyn's Island has been regarded as the most easterly home of the Melanesians. Although we know but little of the craniology of the remote and solitary *Easter Island*, and although the inhabitants are said to be Polynesians from Rarotonga,[2] yet the only skull from this island, so far as I know, in any collection, viz., that in the Museum of the College of Surgeons, has, according to Prof. Flower, a breadth index 69·1 and a height index 72·9. In both these particulars its characters are Melanesian and not Polynesian. The study of the crania in the Polynesian area has led me therefore to a conclusion similar to that arrived at by Mr W. L. Ranken from a consideration of other data, viz., that the South Sea Islands had been inhabited by Papuans prior to the Mahori colonisation.

The *Gilbert Islanders*, again, in the Micronesian area have apparently a large admixture of Melanesian blood. Of the twenty-two skulls in the Godeffroy Museum,

[1] *Journ. Anthrop. Inst.*, vol. vi. p. 231, 1877.

[2] Meinicke, Die Inseln des stillen Oceans, Zweiter Theil, p. 229.

principally from the islands Majuro and Apamama, measured by Krause, nine had a cephalic index below 75, and the remainder ranged from 75 to 79·5, and of these only six were above 77. In the sixteen skulls, the cephalic index of which was below 77, the vertical index exceeded the cephalic. In three of the crania above 77 the vertical index was less than the cephalic, and in two they were almost equal to each other. Three skulls in the Museum of the College of Surgeons measured by Flower had the cephalic index ranging from 73·1 to 76·5; the vertical index in one specimen was less, in another equal to, in a third greater than the cephalic. Five male crania in the Paris Museum are said by de Quatrefages and Hamy to have a mean cephalic index 73·4 and a mean vertical index 77·3; two female crania a mean cephalic index 75·8 and a mean vertical index 79·4. A large proportion of the Gilbert Island crania which have been examined possess therefore the hypsistenocephalic character of the Melanesian skull. Krause states that prognathism was prominent in only six crania. The study of the skulls of the Gilbert Islanders had convinced him that in them the presence of another type than that of a purely Papuan race could be recognised. The mixed racial characters of the people of these islands has also been referred to by Prof. Meinicke and Mr. A. R. Wallace. The people of Peru Island, one of this group, according to the Rev. G. Turner, state that their ancestors came from Samoa, and both persons and places have Samoan names.

The *Marshall Islanders*, to the immediate north of the Gilbert Islands, have contributed but few skulls to museums. Two are in the Godeffroy collection, the one with a cephalic index 75 and a vertical index 79·3, the other with a cephalic index 77·4 and a vertical index 80·3. What little we do know of their crania points therefore to a mixture probably of the Polynesian with the Melanesian type. Krause states that these skulls approach closer to the Caroline than to the Gilbert Islanders.

The *Caroline Islanders* are much more extensively represented in museums. Prof. van der Hoeven described in 1865 a collection of nine skulls, seven men and two women, believed to be natives of Oolea, one of these islands,[1] and an excellent abstract of his memoir was published by the late Dr. Barnard Davis.[2] The mean length of these crania was 182 mm., their mean breadth 126 mm., their mean height 142 mm.; the mean cephalic index is therefore 69·2, the mean vertical index 78. These skulls are long, narrow, and high; they are hypsistenocephalic, and all possess this character. The Godeffroy Museum possesses forty-six skulls from this group, including one from the Pelew Islands. Eight skulls from Ponapé and Nemma were (with one exception C.I. 76) distinctly

[1] Beschrijving van Schedels van Inboorlingen der Carolina-Eilanden, Amsterdam, 1865.

[2] *Anthropological Review*, vol. iv. p. 47, 1866. Mr W. P. Pritchard comments in the same vol., p. 165, on Dr Davis's memoir, and furnishes interesting information on the spiral tufts in the hair of the people of Oceania. He doubts whether the hair grows naturally in these tufts, with bare spaces between, and considers that the tufts are directly the result of an artificial process, and that both they and the "mop-head" can be and are produced both by the frizzly-haired Melanesians and straight-haired Polynesians. See on this point my observations on the hair of a New Zealand head in note on p. 108.

dolichocephalic; the mean cephalic index was 72·2, and the mean vertical index 75·8. Sixteen skulls from the Mortlock Islands had a mean C.I. 74 and a mean V.I. 79. Eighteen skulls from Ruk had a mean C.I. 75·5 and V.I. 77·4. Three skulls from Yap had a mean C.I. 78·5 and V.I. 79·1, whilst the only Pelew Island skull had C.I. 83·8 and V.I. 85·6. Thus, as Dr. Krause has pointed out, the form of the skull in the Caroline Archipelago changes materially from east to west. In the easternmost islands the crania are dolichocephalic of the Melanesian type, whilst the skull from the western Pelew is brachycephalic, and those from Yap are in the higher term of the mesaticephalic. In passing from east to west therefore the cephalic index gradually rises. The western islanders have come under the influence of a brachycephalic race, which is apparently not Polynesian but Malay or Negrito, and this accords with the observations of several travellers. But further, I may state that the crania with a low cephalic index had the vertical index relatively much higher, whilst in the mesaticephali they closely approached each other, and in the only brachycephalic skull, the vertical exceeded the cephalic index.

Crania from the small *Hermit*, *Anchorites*, and *Echiquier Islands*, which lie to the south of the Caroline Islands, and to the immediate west of the Admiralty Islands, are in the Godeffroy Museum. The only skull from Hermit has a breadth index 80·4 and a height index 73·6.[1] The skull from the Anchorites has a breadth index 79 and a height index 73·3. Two other skulls from the Anchorites in the Berlin Museum have been measured by Dr Rabl-Rückhard; the one had a breadth index 78·5, the other a breadth index 77·9 and a height index 78·9. The two Godeffroy skulls from the Echiquier Islands have the cephalic index respectively 74·1 and 78·6, and the vertical index 77·4, 80·5. Another skull from the Echiquier Archipelago is referred to by de Quatrefages and Hamy (p. 204), as having been described by MM. Incoronato and Tocco. Its antero-posterior maximum was 166 mm., its transverse maximum 135 mm., and its cephalic index 81·3. These crania are of course too few on which to base a generalisation, but they point to a considerable mixture of a brachycephalic race with the Melanesian element, which, from the proximity of these small islands to New Guinea, the Admiralty Islands, and New Britain, one would have expected to be the dominant race. The brachycephalic element in these cases is probably Negrito.

The general survey which I have now taken of the craniology of the Pacific islanders, and the evidence collected by MM. de Quatrefages and Hamy, although not so full as that now brought together in this Report, have established on a sufficiently broad basis the important fact that in comparatively few of these islands, or groups of islands, are the crania restricted to either a simple dolichocephalic or brachycephalic standard. Both forms do without doubt occur in their pure state, but along with them skulls of mixed or mesaticephalic proportions are not unfrequently

[1] Krause's measurements; but Virchow puts the height index at 74·4 (*Zeitschr. f. Ethnol.*, Bd. viii. p. 291, 1876).

mingled. These variations can be sufficiently accounted for on the theory that two distinct races, a dolichocephalic Papuan and a brachycephalic Mahori, are in some islands pure, in others mingled with each other, either in distinct colonies living side by side in the same island, or by intermarriage; though on the western side of the Pacific region the brachycephalic Malay and Negrito have without doubt exercised an influence in modifying the cranial and other characters of some of the islanders in that region. But this theory, although combining a large mass of facts, yet does not overtake all the ethnological problems presented by the study of the anthropology of this extensive and widely scattered archipelago. There are certain residual quantities, of which it is not possible to give a satisfactory explanation on the supposition that these are the only races which have ever occupied these islands. I refer more especially to the remarkable archæological monuments that have been found in certain of them. Of these the megalithic remains on Ponapé or Ascension Island; the megalithic platforms, stone houses, and colossal stone sculptures of the human figure on Easter Island, the curious cruciform stone platforms on Malden's Island, the megalithic dolmens on Rotumah, to the north of the Fiji Islands, and the megalithic monuments in Tongatabu and some of the Gilbert Islands are the most noticeable. The natives appear to have no traditions of the construction of these massive remains, and to be themselves unable now to erect similar objects. The question therefore arises, have they so far degenerated from some higher grade of intellectual development as to have lost both all memory of the deeds of their ancestors and the power of executing such works, or did these owe their origin to some pre-existing race which inhabited the Pacific region. We cannot look to Australia as a centre of migration to the northwards of a race possessing a higher culture and civilisation, capable of architectural design and execution, for the aboriginal Australians are in their intellectual development and knowledge of useful arts much below either the Polynesians or the Melanesians, and besides, they are not a sea-faring people. Neither does it seem probable that, if these remains had been constructed by early Polynesian settlers, all memory of them would have departed, for there is ample evidence on many of the islands inhabited by the Polynesians of the propagation by oral tradition throughout hundreds of years of the valorous acts of their great chiefs. Mr. W. Colenso has gathered[1] from the modern Maoris a most interesting set of legends which have been transmitted for centuries from father to son; the Rev. W. Wyatt Gill has collected traditions from the Hervey Islanders embracing five or six centuries;[2] and the Rev. George Turner tells us[3] that the Samoans trace the genealogy of the chiefs of the Malietoa family for twenty-three generations.

Various theories have been advanced as to the origin of the Mahoris or brown Polynesians. They have been regarded by a few as of American descent, and as having

[1] *Trans. New Zealand Institute*, vols. i. xi. xiii. xiv.
[2] *Journ. Anthrop. Inst.*, vol. vi. p. 7, 1877.
[3] Samoa a Hundred Years Ago, London, 1884.

diffused themselves over the eastern islands of the Pacific in the course of the trade winds. Most writers have regarded their origin as Asiatic. Some of these consider that they are derived from the Malays,[1] hence the term Malayo-Polynesian so often applied to them, others again consider that both the Polynesians and Malays sprang from a common Asiatic stock, and that they both migrated from this common centre along independent routes to their respective geographical areas. Mr. W. H. Ranken considers[2] that this stock was Mongolian, as oblique eyes are common in Samoa, and in Tahiti many a Chinese labourer might be mistaken for a native. Others again think that we are to look to Hindustan for the origin of the Polynesians. Others again have accounted for the people of the Pacific, both Polynesians and Melanesians, on the theory so ably advocated by Charles Darwin that the Pacific is an area of subsidence, "and its great wide-spread groups of coral reefs mark out the position of former continents and islands," and that "the races of men now inhabiting these countries are therefore most probably the descendants of the races which inhabited these continents and islands."[3]

Dr. Krause accounts[4] for the Melanesian people of the Pacific by supposing that in prehistoric times a great south oceanic continent existed, which extended from the east of Africa up to the Indian Ocean, from which the black race spread into both Africa and the South Seas, to their present habitat. The deep sea investigations of the Challenger, as well as the absence of characteristic continental rocks in Oceanic islands,[5] have, however, by the demonstration of the great depth of the Pacific and Indian Oceans, and by the apparent absence of any great changes in the bed of those oceans since Tertiary times, thrown great doubt upon the possibility of such an extensive continent ever having had any existence in either the Indian or Pacific Oceans.

As regards the hypothesis of Mr. Wallace—that the brown and the black peoples, the Mahori and Melanesian, are merely varying forms of one great Oceanic race, the diversities of which are to be accounted for from "the old but certain effects of the varying physical conditions which have resulted in the present state"[6] of the surface of the land in Oceania —it is difficult to understand wherein such varying physical conditions could reside in islands subject to such uniform or closely allied climatic conditions, as the New Hebrides and Tonga, even on the supposition that they had at one time been the tops of continental mountains, so as to produce in one a black-skinned, frizzly-haired, dolichocephalic stock, and in the other a brown-skinned, straight-haired, brachycephalic people.

[1] Amongst recent writers the Rev. S. Whitmee has most strongly advocated the affinities between the Malays and Polynesians (*Contemporary Review*, Feb. 1873).

[2] *Op. cit.*

[3] A. R. Wallace, *Trans. Ethnol. Soc. Lond.*, vol. iii. p. 196, 1864, and Malay Archipelago, vol. ii.

[4] Die ethnograph.-anthr. Abtheilung des Godeffroy Museum.

[5] Paper by Mr. John Murray, Coral Reefs, *Proc. Roy. Soc. Edin.*, April 5, 1880, also joint paper by the Abbé Renard and Mr. Murray, *Proc. Roy. Soc. Edin.*, vol. xii. p. 495, 1884, and *Nature*, vol. xxx. pp. 84, 114, 132, 1884.

[6] Man in the Malay Archipelago, *Trans. Ethn. Soc. of Lond.*, vol. iii. p. 213.

GENERAL SUMMARY.

It is perhaps scarcely necessary that I should remind the reader that the one hundred and forty-three crania described and tabulated in this Report are from aboriginal people, living in a state of uncivilisation, in Southern Africa, Southern America, Australia, and the islands of the Pacific Ocean. That they are uncultivated aborigines is, however, a fact which should not be lost sight of in connection with this general summary of their characters.

In the first place I shall refer to noteworthy individual peculiarities observed in these crania. No skull was metopic, though in a young male Australian, a Loyalty Islander, and in two New Guinea skulls traces of the frontal suture were seen in the glabella, and in the Mallicollese it extended as high as the ophryon. The non-persistence of the frontal suture in the adult skulls of savages has been referred to by other craniologists, and is to be associated with the growth in thickness and weight of the cranial walls, the comparative simplicity of the sutures of the cranial vault, and the tendency to ossification of the sutures in adult life, which can so well be observed in the skulls of Australians, Chatham Islanders, and African negroes. In no skull was the malar bone either wholly or partially divided into two by a suture.[1] Wormian bones were present in the lambdoidal suture in Fuegian, Bush, Australian, Admiralty, Sandwich, Chatham, and Loyalty Islanders, Mallicollese and New Zealand crania; in some cases they were of considerable size, and in one Chatham islander attained the magnitude of an interparietal bone. No specific ethnological signification attaches to the presence of these bones. I have seen large interparietal bones in many European crania, and the view that an interparietal bone, the os incæ of Tschudi, had some special significance as a character of the Peruvian skull has now for many years been abandoned.[2]

In the crania of three Australians, two Admiralty Islanders, two Sandwich Islanders,

[1] Much stress has been laid by Prof. Rolleston on division of the malar bone in the Bush skull (account of Bush skulls in his collected papers, *op. cit.*). In his memoir, as well as in Prof. Wenzel Gruber's monograph, Ueber das zweigetheilte Jochbein, Wien, 1873, a copious bibliography may be found. Subsequently Dr. A. B. Meyer has communicated to the Berlin Anthropological Society (*Zeitschr. f. Ethn.* Bd. xiii. p. 330, 1881) a paper on this subject. He has met with two skulls, a Parisian and a Saxon, in 898 crania examined.

[2] See my paper, On some Congenital Deformities of the Human Cranium, *Edinburgh Medical Journal*, July and August 1865.

two New Guinea skulls, and one New Zealander, a tongue-shaped process of the squamous temporal intervened between the parietal and alisphenoid and articulated with the frontal. In the skulls of a Fuegian, two Australians, four Admiralty Islanders, four Sandwich Islanders, two Chatham Islanders, a Loyalty Islander, a Mallicollese, and a New Zealander, epipteric bones were found in the pterion on one or both sides. Owing to the squamoso-frontal articulation in the region of the pterion being a common character in many though not in all of the anthropoid apes, the occurrence of a similar articulation in the human skull has been regarded as a mark of degradation. In a paper which I wrote on the skull of the Gorilla, nearly twenty years ago,[1] I showed that the squamoso-frontal articulation although very common was not constant in the skulls of anthropoid and other apes, and that it might occur not only in the crania of savage man, *e.g.*, Negro, Hottentot, Caffre, Bushman, Sandwich islander, and Australian, but also in Hindoos, Ceylonese, and Europeans, and I stated that it was to be regarded as an individual peculiarity and not a racial character. I also referred to the triquetral bones occasionally present in the spheno-parietal suture as an approximation to this arrangement. Shortly afterwards Dr. H. Allen published observations on the Morton collection in Philadelphia,[2] and pointed out that twenty-three of the eleven hundred skulls in that collection had this articulation, viz., twelve Negroes and one each of the following:—Anglo-Saxon, Pelasgic, Swede, Chinese, Hindoo, Bengalese, Mandar, Seminole, Blackfoot and Iroquois Indian, and Esquimaux. Important memoirs on this subject have subsequently been written by Hyrtl,[3] Wenzel Gruber,[4] Calori,[5] Virchow,[6] Zuckerkandl,[7] Ranke,[8] Retzius,[9] Anoutschine,[10] Stieda,[11] and Schlocker.[12] In connection also with the non-articulation of the ali-sphenoid with the parietal, the presence and frequency of small triquetral or epipteric bones in the pterion has been inquired into, and the result has been to extend still further our knowledge of the races and varieties of men in which either a squamoso-frontal articulation or epipteric bones have been seen, so that now there is scarcely a race or variety in which they have not been described.

In each group of skulls, except the Fuegian, specimens occurred in which a suture

[1] *Proc. Roy. Soc. Edin.*, January 16, 1865.
[2] *Proc. Acad. Nat. Sci. Philad.*, No. 1, p. 137, 1867.
[3] Vergangenheit und Gegenwart des Museums an der Wiener Universität, 1869.
[4] *Mém. Acad. Sci. St. Petersb.*, 1874.
[5] Sull' anomala sutura, &c., Bologna, 1874.
[6] *Abhandl. k. k. Akad. d. Wiss. Berlin*, 1875; and *Zeitschr. f. Ethnol.*, Bd. xii. p. 1, 1880.
[7] Reise der Novara, Anthrop. Theil., p. 110, 1875.
[8] Beiträge zur Anthrop. u. Urgeschichte Bayerns, Bd. i., 1877.
[9] Finska Kranier, Stockholm, 1878.
[10] *Bull. de la Soc. d'Anthrop. de Paris*, 1878.
[11] *Archiv f. Anthrop.*, Bd. xi. p. 110, 1879.
[12] Anomalien des Pterion. *Inaugural Dissertation*, Dorpat, 1879. In addition to the above, isolated cases of squamoso-frontal articulation had previously been observed by Meckel, Owen, Henle, and von Baer.

extended from the infra-orbital foramen into the infra-orbital canal and floor of the orbit.[1] Although the presence of an infra-orbital suture, as will have been gathered from the descriptions in this Report, is a by no means uncommon occurrence in the human skull, yet very little attention has been given to it by anatomists. Prof. Wenzel Gruber has indeed, in a memoir on the infra-orbital canal,[2] figured in one skull a suture extending from the infra-orbital foramen through the lower border of the orbit into an anomalous infra-orbital canal, and a similar suture has been figured but not described by Virchow.[3] The peculiarity of the special fronto-maxillary articulation in the inner wall of the orbit in a Bush skull, and of a division of the parietal bone in an Admiralty Islander, have already been described in the Report (pp. 12, 57). Paramastoid processes occurred in a Bush, a Fuegian, two Sandwich Islanders, and a Chatham Islander. A mesial third occipital condyle was present in an Admiralty Islander, a Sandwich Islander, a Chatham Islander, and a New Zealander. Dr. H. Allen states that in the Morton collection of crania ten specimens possessed a third occipital condyle, and Dr. Barnard Davis also mentions several specimens in his collection as possessing it. The spheno-pterygoid foramen was seen in the skulls of two Sandwich and a Chatham Islander. In some other specimens although the external pterygoid and sphenoidal spine were not quite continuous, yet they so closely approached that in the living head they had probably been connected by a fibrous band, the pterygo-spinous ligament of Civinini.

Exostoses from the wall of the external auditory meatus were found in four Sandwich Islanders, a Chatham Islander, and a New Zealander. From observations which I have elsewhere recorded on this subject,[4] I was at that time led to state that there was a tendency to the development amongst the aborigines of America of modifications in the configuration of the external auditory passage. If, along with the crania described in this Report, we were to include the Marquesas Islanders described by Prof. Welcker[5] and Dr. Barnard Davis,[6] and the Sandwich and Loyalty Islanders in the collection formed by the latter craniologist, we should also be justified in saying that exostoses in this locality are not uncommon amongst the South Sea Islanders. The skull from the Admiralty Islands, with the remarkable deficiency of the nasal bones, exhibited a rare though not a unique malformation, as Van der Hoeven has referred[7] to a similar condition in a Bush skull, and the skulls of two African negroes in the Barnard Davis collection[8] have no nasal bones. The general absence of decay in the teeth, notwithstanding the frequent

[1] I have omitted, I find, in the description of the Bush crania, to refer to this character, but this suture was present in one skull of that race.

[2] *Mem. Acad. Sci. St. Petersb.*, 1874.

[3] Niedere Menschenrassen, *Abhandl. d. Berlin Akad.*, pl. vi. fig. 1, 1875.

[4] On Exostoses within the external Auditory Meatus, *Journ. of Anat. and Phys.*, vol. xiii. p. 200.

[5] *Archiv. für Ohrenheilkunde*, vol. i.

[6] Thesaurus Craniorum, and Supplement.

[7] Catalogus Craniorum, No. 165, p. 58, 1860.

[8] Thesaurus Craniorum, pp. 206 208, Nos. 1461, 1066.

exposure of the dentine as a result of use, is in accordance with the observations of many craniologists, that primitive man is much less subject to diseases of the teeth than man in a more civilized condition.[1]

Of the several peculiarities above described, some, such as the presence of an inter-parietal bone, a squamoso-frontal articulation in the pterion, a maxillo-frontal articulation in the inner wall of the orbit, a spheno-pterygoid foramen, and paramastoid processes are arrangements which are normal in various mammals though not in man. When they appear in the human cranium they are reversions to a lower type, and it is not without interest to consider if such reversions occur more commonly in savage than in civilised races.

The one hundred and forty-three crania described in this Report were collected without any reference to individual anatomical peculiarities, but simply as the skulls of races of men, which happened to come in the way of myself and other collectors. But amongst them, although their number is certainly too limited to base any broad generalisation on, as to the relative frequency of occurrence of particular variations in the different races, there is obviously a larger proportion of important variations than would occur in a corresponding number of skulls of the white races. Take the squamoso-frontal articulation, for example. It was seen in ten skulls, whilst epipteric bones were present in sixteen crania, which gives for the squamoso-frontal joint a proportion of 7 per cent., and for the epipteric bones a proportion of 11 per cent. This proportion is very much larger than was observed by Prof. Ranke in a series of two thousand four hundred and twenty-one crania of old Bavarian people, in which forty-three specimens had a complete articulation of the frontal with the squamoso-temporal, being in the proportion of 1·7 per cent. Virchow has added to Ranke's series of old Bavarian skulls observations on upwards of one thousand collected from other parts of Germany, so as to make a total of three thousand six hundred and ten German skulls, in 1·6 per cent. of which this articulation occurred. Calori also found this articulation in Italian skulls ten times in one thousand and eighteen specimens, or 1 per cent. Wenzel Gruber observed it in sixty crania in his collection of four thousand specimens. These crania represented different nationalities of Russia, and were probably for the most part Sclavonic, and the proportion is 1·5 per cent. These observations give a proportion of something less than 2 per cent. of European crania in which the squamous-temporal articulated with the frontal. We have no correspondingly large observations on the coloured races, but the frequency with which this variation has been noticed in certain of them shows that it is not uncommon. I have already referred (p. 116) to Dr. Allen having seen it in twelve Negroes in the Morton collection, which, judging from Dr. Aitken Meigs's Catalogue,[2] contains one hundred and seventeen negro skulls. Ecker found it ten times in the series of fifty negro crania in

[1] See especially the remarks made by Prof. Rolleston in British Barrows, p. 701.

[2] Philadelphia, 1857.

the collection in the Freiburg Museum. Anoutschine puts its occurrence in the negro skull at 12·8 per cent. He also gives its proportion in the Papuan skulls, based on the observations of A. B. Meyer and Mantegazza on three hundred and thirty-six skulls, at 6·9 per cent., and on thirty-nine crania examined by himself at 5·1 per cent. Flower found it in the Australian skulls examined by him in the proportion of 9 per cent.,[1] but Virchow, who has summarised[2] observations by various authors on one hundred and forty-two Australian crania, places it at 16·9 per cent. On the other hand the squamoso-frontal articulation does not appear to have been seen in any Tasmanian skull. Anoutschine gives the proportion of its occurrence in one hundred and eighty Polynesian crania at 3·3 per cent. and in one hundred and sixty-six Malay skulls at 4·8 per cent.[3]

The spheno-pterygoid foramen is also a variation of considerable interest in the human skull. It was seen with complete osseous boundaries in three of the skulls on which I have reported. A memoir on this foramen has recently been written by Dr. Eugen Roth,[4] who states that he has seen it with complete bony boundary ten times in two hundred and seven European crania, *i.e.*, 4·8 per cent. He puts its percentage with partial and complete bony walls, amongst exotic crania very much higher, 32 per cent. in Asiatics; 50 per cent. in Australians and Papuans; 30·6 per cent. in Africans; and 20 per cent. in American Indians, but the number of skulls of these coloured races which he has examined is far too small on which to frame any sound generalisation.[5]

In addition to the measurements of the crania recorded in the several Tables printed in the early part of this Report, I selected at least one characteristic specimen of each group of skulls, and bisected it longitudinally and vertically immediately to one side of the septum nasi and mesial plane of the cranial cavity. A careful rubbing was then taken of the outline of the section of each skull, and on this several lines were drawn and angles measured. As to the importance of this method of studying the skull I am quite in accordance with Profs. Huxley[6] and Cleland.[7] Indeed I may say that I had looked at the comparative anatomy of the skull from this point of view many years ago, when I

[1] Native races of the Pacific Ocean.

[2] *Zeitschr. f. Ethnol.*, Bd. xii. p. 20, 1880.

[3] Dr. Schlocker in his *Inaugural Dissertation*, Dorpat, 1879, "Die Anomalien des Pterion," discusses how the squamoso-frontal articulation arises, and this question is also considered by J. B. Sutton in *Journ. Anat. and Phys.*, vol. xvii. p. 220, 1884. It would seem as if an epipteric bone is normal in the development of the human skull, and usually joins the parietal to form its antero-inferior angle. If it fuses instead with the squamosal or frontal then it connects those bones and cuts off the parietal from the ali-sphenoid. Sometimes it remains up to adult life as a distinct epipteric bone.

[4] *Archiv f. Anthrop.*, Bd. xiv. p. 73, 1882.

[5] I may also refer to Dr. Krause's measurements of the skulls in the Godeffroy Museum, for several examples of this and the other forms of cranial variation described in the text.

[6] Two widely contrasted forms of the Human Cranium, *Journ. Anat. and Phys.*, p. 60, Nov. 1866.

[7] Variations of the Human Skull, *Phil. Trans.*, 1869; and Description of a Sulu Skull in *Journ. Anat. and Phys.*, p. 663, July 1877.

was working at the anatomical relations of the tentorium to the cerebrum and cerebellum.[1] The modifications in the thickness of the two tables and of the diplöe of the bones of the cranial vault, and the extent of the frontal and sphenoidal sinuses are revealed in such sections. It is interesting to observe that the massive skull of the Chatham Islander and that of the New Zealander had no frontal sinus in the glabella; in the Bush skull this sinus had both great vertical and lateral extension.

In the first place, I have drawn from a common centre a number of radii to definite points on the surface in the mesial line of the outer table. The centre I have selected is the basion, to the importance of which I have already referred in the introduction to this Report. I have also drawn a line in the plane of the foramen magnum and erected a

TABLE XVIII. (Plates VI., VII.)

RADII.	Bush. Umzimkulu.	Fuegian. D.	Admiralty Islander. A.	Oahu. D.	Hawaii. B.	New Zealand. Waikato.	Chatham Islander. A.	Queensland, Australia.	Gipps Land, Aust.	Australia.
Basi-occipital,	94	108	110	110	106	96	106	113	105	104
Basi-lambdoidal,	111	123	120	130	122	112	120	115	111	110
Perpendicular,	129	139	147	147	146	138	144	132	126	128
Basi-coronal or bregmatic,	130	138	144	146	143	134	144	135	124	133
Basi-glabellar,	107	111	106	113	108	110	121	108	101	114
Basi-nasal,	104	106	100	107	102	104	113	97	95	102
Basi-alveolar,	99	102	98	110	100	101	106	100	94	108
From perpendicular radius to most anterior part of cranial cavity,	89	79	82	80	87	88	92	94	83	91
From perpendicular radius to most posterior part of cranial cavity,	75	84	87	84	74	71	76	73	82	72

perpendicular from the anterior end of this line at the basion, which intersects the cranial vault at a point behind the bregma. This point varies within certain limits in different skulls according to the inclination of the plane of the foramen magnum, for it is thrown backwards or forwards according as that plane diverges from or approaches the horizontal plane of the head. Speaking generally, it may be said to touch the cranial vault in more or less close proximity to the spot which corresponds to the upper end of the fissure of Rolando.[2] In the Admiralty Islander it was 18 mm., in the Oahuan 19, the Fuegian 22, the Chatham Islander 23, the Hawaian 31, the New Zealander 34, the Bush 37, one

[1] *Proc. Roy. Soc. Edin.*, March 3, 1862. The drawings and tracings which I made at that time have not been published.

[2] See my papers On the Relations of the Convolutions to the Outer Surface of the Skull and Head, in *Journ. Anat. and Phys.*, vol. viii. pp. 142 and 359; also Mr. Hare's paper in the same *Journal*, vol. xviii. p. 174.

Australian 26, another 44, another 55 mm. behind the bregma. There are two factors which influence the relation of this point to the bregma, viz., the inclination of the plane of the foramen magnum and the relative length of the longitudinal arc of the frontal bone. This line I shall call the perpendicular radius, and the extent of cranial cavity which lies anterior to it, and in relation to the cranial vault, will approximately correspond to the frontal lobes of the cerebrum. I have constructed Table XVIII., in which is given the length of these different radii expressed in millimetres in the series of skulls which have been measured, and to them I have also added for convenience of reference the basi-nasal and basi-alveolar diameters obtained in the previous measurements by the callipers. The new radial measurements are as follows:—basi-occipital from basion to occipital point; basi-lambdoidal from basion to lambdoidal suture; perpendicular from basion to cranial vault perpendicular to plane of foramen magnum; basi-glabellar from basion to the most projecting part of the glabella; whilst the basi-coronal from basion to coronal suture, corresponds with the basi-bregmatic diameter.

From the perpendicular radius the distance was measured to both the most anterior and most posterior parts of the cranial cavity, and these measurements are also recorded in this Table. It will be seen that in the dolichocephalic Fuegian, Admiralty Islander, and Oahuan skulls, the extent of brain cavity behind the perpendicular radius exceeded that which was in front by several millimetres; in the mesaticephalic Bush, New Zealander, and Chatham Islander, and in the brachycephalic Hawaian, on the other hand, a larger proportion of the cavity was in front of than behind the perpendicular radius.

It would seem therefore as if in the formation of some dolichocephalic skulls, the growth takes place backwards, behind the plane indicated by the perpendicular radius, to a greater extent than in front of the same plane. This remark, however, must not be made too absolutely, for, owing to the plane of the foramen magnum not always possessing the same definite relation to the horizontal plane of the head, the perpendicular radius may, as already stated, be moved forwards and backwards. Thus in two of the three dolichocephalic Australian skulls measured in the above Table, where the plane of the foramen magnum sloped backwards, the frontal division of the cavity exceeded the occipital by a number of millimetres; but in the dolichoplatycephalic Gippsland skull, where the perpendicular radius reached the cranial vault much closer to the bregma, the anterior and posterior divisions of the cranial cavity were nearly equal. It will also be seen that, in accordance with the development of the cranial cavity behind the perpendicular radius, the basi-occipital and basi-lambdoidal radii attained considerable magnitude in the dolichocephali, and in the brachycephalic and mesaticephalic skulls the basi-glabellar radius preponderated over the basi-occipital. The tapeinocephalic character of both the Bush and Gippsland crania is well shown by the shortness of both the perpendicular and basi-bregmatic radii.

Another relation to which my attention has been directed is the angle which a line

drawn from the basion through the basi-occipital and sphenoid bones to the sphenoido-ethmoid articulation in the anterior cerebral fossa, forms with a line from the same point in the sphenoido-frontal articulation drawn parallel to the cribriform plate of the ethmoid through the upper end of the ethmo-frontal suture. These lines, which I shall call the basi-occipito-sphenoid axis and the cribriform axis, and the angle formed by their intersection, the sphenoido-ethmoid angle, have been studied by Prof. Huxley,[1] and to the first of the two lines he has given the name of basi-cranial axis. Almost similar lines have also been drawn by Prof. Cleland[2] and named by him the middle base and the frontal base, whilst the plane of the foramen magnum he regards as the hindmost division of the base of the skull. The length of these lines expressed in millimetres and the angle formed by their intersection in the same skulls as those measured in Table XVIII. are given in Table XIX. The angle which the basi-occipito-sphenoid axis forms with the plane of the foramen magnum is named the foramino-basal angle in the same Table.

TABLE XIX. (Plates VI., VII.)

Collection,	Bush. Umzimkulu.	Fuegian. A.	Admiralty Islander. A.	Oahu. D.	Hawaii. B.	New Zealand. Waikato.	Chatham Island. A.	Australia. Queensland.	Australia. Gippsland.	Australia.
Basi-occipito-sphenoid axis,	59	64	64	66	65	69	70	59	55	63
Cribriform axis,	28	29	30	22	21	21	24	34	28	28
Sphenoido-ethmoid angle,	142°	139°	148°	148°	147°	154°	150°	136°	138°	138°
Foramino-sellar angle,	126°	125°	115°	123°	130°	140°	132°	129°	124°	127°
Foramino-basal angle,	147°	138°	143°	140°	146°	151°	146°	157°	139°	150°
Spheno-maxillary line,	72	79	72	73	69	72	79	79	72	85
Spheno-maxillary angle,	94°	89°	90°	101°	93°	92°	91°	91°	93°	93°
Base line,	136	137	128	140	135	135	144	130	127	136
Frontal chord,	113	109	121	113	113	112	122	118	102	108
Parietal ,,	113	111	127	104	114	106	108	121	115	119
Occipital ,,	91	103	96	111	103	96	103	99	87	91

The basi-occipito-sphenoid axis is not necessarily parallel to the plane of the surface of this part of the cranial base, *i.e.*, to the dorsum sellæ, so that the angle which it makes with the plane of the foramen magnum does not express how far the slope of the dorsum sellæ approaches or departs from the perpendicular radius. I have accordingly drawn a line parallel with the dorsum sellæ to cut the plane of the foramen, and have inscribed the angle formed by their intersection in Table XIX. as the foramino-sellar angle. It will be seen that the inclination of the dorsum sellæ to the plane of the foramen magnum exhibited a considerable range of variation in the series of crania measured. In the Admiralty Islander it approached closer to a right angle than in any of the others, whilst in the New Zealander it opened out to 140°. Very little variation in the foramino-sellar angle occurred in the three Australian skulls. The foramino-basal angle formed by the

[1] Two widely contrasted forms of Human Skulls, *Journ. Anat. and Phys.*; November 1866.

[2] Description of a Sulu skull, *Journ. Anat. and Phys.*, July 1877.

basi-occipito-sphenoid axis with the plane of the foramen magnum presented considerable variations in the different crania; in the Fuegian it was the lowest, 138°, and it reached its maximum in one of the Australians 157°, but amongst the three Australians it ranged from 139° to 157°. In each skull it was more open than the foramino-sellar angle in the same cranium.

The sphenoido-ethmoid angle presented considerable variation in these crania. Prof. Huxley, in speaking of his corresponding angle, which he calls the basi-ethmoid angle, states that it diminishes in proportion to the downward rotation of the cribriform plate, *i.e.*, in proportion to the departure of the human skull from the arrangement of that plate seen in the lower mammalia. But the cribriform axis is not the only factor in the formation of this angle, for the slope of the basi-occipito-sphenoid axis is not uniform in all crania, and the nearer that the latter axis approaches to the vertical the more would the sphenoido-ethmoid angle be diminished, just as if a downward rotation of the cribriform plate had taken place. Table XIX. shows that this angle possessed a considerable range of variation. It was most open in the New Zealander and Chatham Islander, whilst in the three Australians and the Fuegian it was almost uniform at from 136° to 138°.[1]

A line was also drawn from the spheno-ethmoid articulation to the most projecting point of the upper jaw-bone and named in the Table the spheno-maxillary line, and the spheno-maxillary angle, which it formed with the basi-occipito-sphenoid axis was measured. The spheno-maxillary line varied considerably in length in the several skulls. It was shortest, 69 mm., in the brachycephalic, mesognathic Hawaian, and it attained its maximum, 85 mm., in a dolichocephalic, prognathic Australian, the gnathic index of which was 105·8. It possessed also considerable length, 79 mm., in the Chatham Islander and Fuegian skulls, but in neither of these did the gnathic index exceed 98, so that these crania were not prognathic. There was comparatively little variation in the spheno-maxillary angle which, in the majority of the skulls measured, exceeded by a very little a right angle, though in the Fuegian A it sank to 89°, and in the prognathic Oahuan D it rose to 101°. The projection of the upper jaw is not the only factor which affects this angle. Undoubtedly when the forward projection of this bone is considerable the tendency of this angle is to become more open, but should the slope of the basi-occipito-sphenoid axis at the same time approach the vertical then the angle would be relatively diminished. Hence I cannot regard this angle as giving an accurate measure of the degree of prognathism.

The base line from the back of the foramen magnum to the fronto-nasal suture, proposed by Prof. Cleland is also given in Table XIX., and as the total longitudinal arc

[1] Prof. Goodsir says that in man the cribriform side of this angle is, in well formed heads, horizontal. In the descending animal series this side rises so as at last to assume the rectangular position (see Lectures on the Dignity of the Human Body, in collected Anatomical Memoirs, vol. i. p. 258. Edinburgh, 1868).

of the vault of the several crania, except that of the Australian in the last column, has been given in the previous Tables under their respective headings, the relation as regards the relative length of the one to the other can be easily computed. Of the Australian skull, a male above referred to as excepted, I possess only one half, so that I have not included it in either Tables III. or IV., but I may state here that its total longitudinal arc is 374 mm.—the frontal 130 mm., parietal 125 mm., occipital 119 mm.

The chords of the frontal, parietal, and occipital arcs are also recorded in Table XIX. As Dr. Cleland has pointed out in his paper on the Sulu skull, the occipital arc possesses in dolichocephalic skulls a very pronounced curvature. The contrast between the curvature of that bone in the dolichocephali figured in Plates VI. and VII., and the corresponding bone in the brachycephalic Hawaian is very marked. There is obviously no relation between the length of the basi-occipito-sphenoid axis, and either the absolute length of the skull or its length relatively to its breadth. Thus this axis in the brachycephalic Hawaian varied only one millimetre in length from the same axis in the dolichocephalic Fuegian, Admiralty Islander, and skull from Oahu, and only 2 mm. from one of the dolichocephalic Australians, a result which accords with the observations made by Prof. Huxley on his two widely contrasted forms of skulls. As regards the relations of the transverse diameters of the side walls of the skull to the length of this axis, it will be seen that the stephanic and parietal diameters were greater in the Hawaian than in the Admiralty Islander, Fuegian, and Oahuan, but that the asterionic diameter, though greater in the Hawaian than in the Oahuan, was less in it than in the Fuegian and Admiralty Islander. It would seem therefore as if in brachycephalic as compared with dolichocephalic crania, a greater transverse growth took place in the frontal and parietal regions than in the occipital. The degree of what Prof. Huxley calls the anterior and posterior cerebral overlap may also readily be determined with the aid of the sectional diagrams in Pl. VI. and VII., and the posterior overlap is obviously less in the brachycephalic than in the dolichocephalic skulls.

I may supplement the remarks made in the Introduction on the method of taking the cranial capacity by stating that in the comparative measurements of each skull made by Mr. Jas. Simpson and myself, our measurements corresponded twenty-two times; on twenty-three occasions the difference between us was 10 cc., and in the remaining seventy-four the difference was between 2 and 8 cc. I think therefore it may fairly be assumed that any two persons carefully carrying out a series of observations on the cubic capacity in the manner I have recommended, ought to arrive at results closely corresponding with each other, which may be taken as giving a fair approximation of the internal capacity of the crania examined. The series of observations showed very decidedly that in these savage people the mean cubic capacity of the female skull was distinctly below the male.

Although my Tables do not record the breadth as well as the length of the foramen

magnum, I have taken both these dimensions in a large number of the crania. In far the greater number the length exceeded the breadth—in the Bush skull Chal. B. by as much as 12 mm.—but usually the difference between them was much less, sometimes not more than 1 mm. In one New Zealander and in one Chatham Islander these dimensions were equal. In one Admiralty Islander the breadth exceeded the length by 1 mm., in another by 0·5 mm.

Variations occurred in the series of skulls in the relative width of the face as estimated in the interzygomatic diameter, and that of the cranium in the parietal or parieto-squamous region. In the mesaticephalic Bush and Chatham Islanders, the brachycephalic Hawaians and Oahuans, and the dolichocephalic Admiralty Islanders, the rule was for the interzygomatic diameter to be less than the interparietal; in the male Australians as a rule the interzygomatic was the greater diameter, but in the Fuegians and New Zealanders these relative diameters varied in different crania. In many specimens the greater interparietal breadth was associated in the same cranium with a relatively large interstephanic breadth, so that the skull was cryptozygous; but this was not constant, so that in some of the crania examined the breadth in the parietal region was greater than the interzygomatic diameter, and yet the skulls were phænozygous.

The relative length of the frontal, parietal, and occipital arcs varied materially in the crania under review. As a rule the occipital longitudinal arc was the smallest of the three, but in the Fuegian and so called Patagonian group of skulls the occipital arc was in the majority of the specimens longer than either the frontal or parietal. The relative length of the frontal and parietal arcs was very inconstant. In the whole series of crania, except the New Guinea, the Loyalty and Admiralty Islanders and New Hebrideans, the tendency was for the frontal arc to exceed the parietal, but in the Melanesians it was the rule for the parietal arc to be longer than the frontal, and in the Loyalty Islanders very considerably to exceed it, so that this may be considered as a racial character of the Papuans. In a paper on Cranial Deformities, published twenty years ago, in which I discussed the mode of production of the scaphocephalic skull[1] I stated that one cranial bone might infringe upon the areas of adjacent bones if its ossification proceeded at a more rapid rate than theirs. This will doubtless account for the variations in the relative magnitude of the cranial bones, more especially those of the vault of the skull, in different individuals. For the fibrous primordial matrix in which these bones arise is continuous over the cranial vault, and does not have the limits of the several bones defined in it by sharp lines of demarcation. The ossific spicules, growing at a greater rate from a centre within one area than in the others surrounding it, would necessarily extend the area of the bone to which they belong and give it a greater superficial magnitude. It is probable that in those Melanesian crania in which the parietal longitudinal arc dominates so much over the frontal and occipital, that the parietal ossific centres are relatively more active than both

[1] *Natural History Review*, January 1864.

the frontal and occipital. Skulls which owe their dolichocephalic proportions to this dominating growth of the two parietal bones may appropriately be said to exhibit parietal dolichocephaly. The variations in the length of the arcs in the bones of the cranial vault will necessarily affect the cranial sutures, so that the coronal, squamous, and lambdoidal sutures will vary both in their direction and position within certain limits. As we have no evidence that the lobes of the brain grow commensurately with the bones of the cranium after which they are named, the relation which these lobes, and the fissures separating them from each other, will bear to the cranial sutures will also, as I[1] and others have elsewhere pointed out, vary within certain limits, and these variations will render it difficult to lay down, from an inspection of the surface of the head, absolutely fixed rules for the determination of the position of the cerebral fissures and convolutions.

TABLE XX.

	Bush.	Fuegians.	Australians.[2]	Admiralty Islanders.	Hawaians.	Oahuans brachycephali.	Oahuans dolichocephali.	Oahuans mesaticephali.	Chatham Islanders.	New Zealanders.	New Guinea.	South Sea Islanders.
Cephalic Index, . .	1·5	5·	9·	5·5	2·	5·	3·	4·	8·	11·	19·5	9·6
Vertical ,, . .	4·	3·5	11·	13·	4·	3·	9·	8·	7·	9·	7·5	10·
Gnathic ,, . . .	9·4	3·	16·	18·	7·	5·	14·	11·	8·	11·5	13·	11·
Facial ,, . .	7·	14·	17·	14·	6·	7·	12·	7·	9·8	21·	13·	12·
Nasal ,, . . .	14·5	8·	14·5	17·	11·	12·	11·	10·	12·	20·	10·	4·
Orbital ,, . .	13·	10·	23·	19·	8·	23·5	16·	9·	15·	20·	18·	30·5
Palato-maxillary Index,	16·	6·	23·5	17·	10·	19·	27·	15·	13·	22·	32·	21·

The great importance which has been attached, in the later years of craniological research, to a determination of indices, by a comparison of two dimensions, leads me now to survey the several indices which I have computed in the preceding Tables, with the object of ascertaining which index shows the smallest range of variation in each series of skulls. For convenience of comparison I have arranged in groups in Table XX. the series of skulls examined, and the numerals express the range of variation in their several indices in the adults of each group. From this Table it will be seen that the cephalic and vertical indices showed the smallest amount of variation in each group. In the Bush skulls 1·5 expressed the range of the cephalic index, and in no group did it rise above 10, except in such mixed people as the New Zealanders, where it reached 11, and the New Guinea skulls, which included both brachycephalic and dolichocephalic races. The vertical index was remarkably constant in the Bush, Fuegians, Hawaians, and brachycephalic Oahuans, the range of variation not rising above 4. In the Australians the range was 11, owing to the presence of a proportion of dolichoplatycephalic crania, and

[1] See *Journ. Anat. and Phys.*, vol. viii. pp. 142 and 359.

[2] In estimating the range of variation of the cephalic index in the Australian skull, I have not included the scaphocephalic man from Portland Bay, or the mesaticephalic woman from West Victoria.

the range of 13 in the Admiralty Islanders was due to one skull having the unusually low vertical index of 64. As regards the sexes, my measurements generally confirm those made by preceding craniologists, who give to the female skull a less absolute and relative height than to the male. The gnathic index showed a much greater amount of variation in the several groups than the cephalic and vertical; in only five was the range below 10, whilst in the remaining seven it rose above that figure, and in the Admiralty Islanders was as high as 18. The greatest variation was, however, in the facial, nasal, orbital, and palato-maxillary indices, in which the range was seldom below 10; in several groups the range of one or other of these indices rose to 20, and in two instances to upwards of 30. In his important essays on the orbital and nasal indices[1] Paul Broca fully recognises the variations which may occur in these two indices, and, when writing on the nasal index, he states that it is subject more than most of the other characters to the perturbing influence of individual variations, so that valuable results can only be obtained by taking the average of a sufficiently large number of skulls. My observations on those groups, in which I had a sufficient number of crania of the two sexes, confirm the statement of Broca that in the same race the orbital index in the adult females is higher than in the adult males.

As the palato-maxillary indices in this Report are derived from the examination of the palato-alveolar arch in the crania of uncivilised races, it may be interesting to state the results of the length and breadth measurements of this region in a number of European crania. Twenty male skulls, consisting of ten Scots, five French, and five Germans, had a mean palato-maxillary index of 116·2, *i.e.*, they were brachyuranic, and the range of variation was from 103 to 138. Only three were below 110, *i.e.*, were dolichuranic; seven were between 110 and 115, *i.e.*, mesuranic, and the remaining ten were all above 115; one half, therefore, were brachyuranic, and as many of these had a high index, they raised the mean index of the crania measured. Eight female skulls, consisting of five Scots and three Sclavonic skulls, had a mean palato-maxillary index of 115·6; and they also were in the mean brachyuranic, and the range of variation was from 108 to 121·6. Only one was dolichuranic, three were mesuranic, and the remaining four were brachyuranic. The male and female averages corresponded, therefore, very closely with each other. The greatest length of the palato-maxillary arch in the series of European skulls was 60 mm. (male), and the shortest arch was 47 mm. (male), the widest arch was 69 mm. (two males), and the most contracted arch was 56 mm., both in a male and a female. In no specimen was the length of the region equal to the breadth.

In the series of skulls tabulated in this Report the Australians possessed the largest palato-alveolar arches. The longest arch in this race was 68 mm., and the shortest 48 mm., whilst the widest arch was 74 mm., and the most contracted 53 mm. The New

[1] *Revue d'Anthropologie*, 1875 and 1876.

Zealand crania also contained specimens of considerable magnitude, the longest arch was 62 mm., the shortest 49 mm., the widest was 69 mm., and the most contracted 57 mm. As a rule the breadth of the arch was markedly greater than the length, but in a few crania they approximated to each other and gave rise to a low palato-maxillary index. This was especially seen in the Australians (p. 39). One Admiralty Islander also had a palato-maxillary index of only 104, but the gnathic index in this specimen was moderate. In one dolichocephalic skull from Oahu the palato-maxillary index was only 103, and the gnathic index was moderate; in two others the length and breadth of this arch were equal, and in one of these the gnathic index was prognathous, in the other orthognathous. Although, as already stated in the description of the Australian crania, a dolichuranic palate is frequently associated with prognathism, it by no means follows that they should of necessity go together.

A long palato-alveolar arch is to be regarded as a sign of degradation of the human cranium, and this is the more marked when it is associated with relative narrowness and the consequent production of a low palato-maxillary index. In the anthropoid apes, for example, the length of this region in the adult skull is invariably considerably greater than the breadth, so that the palato-maxillary index is very low. Five skulls of the Gorilla in the Edinburgh University Anatomical Museum have a mean index of only 72, a single adult Orang has an index of 80, and an adult Chimpanzee an index of 82. In the young of the anthropoid apes, as I have determined from the measurements of three young Orang skulls in the same Museum, the length and breadth of the palato-alveolar region closely approximated, and the breadth in one even slightly exceeded the length, so that the index was considerably higher than in the adult. In the youthful stage of the human cranium, owing to the non-development of the true molars and the consequent shortness of the dentary arcade, the breadth of the arch is also greater in proportion to the length than in the adult skull, and the palato-maxillary index is very high. Illustrations of this may be seen in several of the young skulls, the measurements of which are given in the Tables.

Owing to the greater constancy of the cephalic and vertical indices in the same people, it follows that they are the most important features of study to guide the craniologist in his determination of the distinctive characters of races, for it is obvious that the less liable to variation any character is, the more does it stamp the race to which it belongs. The gnathic index ranks also very high as a racial feature, whilst the other indices to which I have referred are only of secondary importance. One cannot therefore but express a feeling of admiration at the acuteness of Anders Retzius, who so many years ago, and with much less refined methods than those employed in modern craniometry, seized upon the relation of the length to the breadth of the cranium, and on the relative amount of projection of the upper jaw as the foundation of his classification of the various races of mankind.

In upholding, however, a system of classification based upon these and other proportions of the skull, I do not wish it to be supposed that I undervalue the importance of other physical characters. The colour of the skin, the colour and character of the hair and eyes, the shape of the nose and lips, the stature, and the form of the pelvis, are all important factors in the determination of the distinctive physical features of races. To say that a series of skulls is dolichocephalic, or that another series is brachycephalic, is merely to express that they have in common a certain relation of length and breadth of the cranium, and by no means indicates that all the dolichocephali belong to one race only, and all the brachycephali to another. But I believe that by taking a combination of cranial characters we can lay down certain propositions as regards unmixed races of men, which, whilst allowing for the occurrence of occasional individual variations, will be as distinctive as those afforded by the study of any other series of physical characters. For variations occur in such characters, as in the cranium itself, and no more striking illustration could be given than the occasional appearance of an albino amongst the coloured races.

In unmixed races, where the skull is markedly dolichocephalic, brachycephalic skulls, one may say, never occur; and similarly in unmixed races, where the skull is markedly brachycephalic, dolichocephalic skulls are not met with. Hence even an unskilled observer would have no difficulty in distinguishing the skull of a Melanesian Loyalty Islander from that of an Andamanese, or that of an Australian from a brachycephalic Sandwich Islander. Similarly the dolichocephalic skull of an African negro, or of a Kaffir, may be readily differentiated from that of a mesaticephalic Bushman. Mixed races again are more difficult to deal with, especially if the mixture be that of a dolichocephalic with a brachycephalic race. For the people resulting from such a mixture will of necessity present many diversities in cranial form. Some will have heads which exhibit, with but little variation, the characters of one or other of the two parent types, but in others intermediate characters will arise, which may incline in some to those of one parent type, in others to those of the other. It is I think through the want of a due recognition of the effects which may be produced on the form of the head by this mixing of races that discredit has been thrown on the value of the skull in the determination of racial characters.

The question may be fairly discussed whether all unmixed races are either dolichocephalic or brachycephalic, and whether mesaticephalic people are invariably due to a mixture with each other of races possessing the two extreme types of head form. There can, I think, be no doubt that the dolichocephalic African negro, the hypsistenocephalic Melanesian, and the dolichocephalic Esquimaux, are all unmixed races. Their cranial and other physical characters are so decided that each of these people is distinctively differentiated from all other races. Similarly the brachycephalic Andamanese, Mongolians, and American Redskins are distinguished by definite characters from each other and from other races.]

have in previous pages given many examples to show how a mesaticephalic people may arise from a mixture of a dolichocephalic with a brachycephalic race. But there are instances of apparently unmixed races in which the standard form of the head is mesaticephalic. I may especially refer to the Bush race of South Africa, which has so many features distinguishing it from the surrounding people that it would seem to be a pure race, and it is not improbably the remains of the primitive people of the African continent. The Tasmanians were mesaticephalic, and it is possible also an unmixed race, though on this point I hesitate to give a definite opinion. I am not disposed, therefore, to limit the unmixed races to those which are either dolichocephalic or brachycephalic in their cranial proportions, but to include also certain of the mesaticephali.

From the examination of the Races of Men described in this Report, we have seen that in South Africa, in the southern part of South America, and in Australia, races of men exist distinguished by the small capacity of their crania, by their low intellectual development, and in the case of the Bushmen and Fuegians by their small stature and generally feeble physical configuration. The Australians also and the now extinct Tasmanians were under the average size of Europeans. In the islands to the south and east of the great Asiatic continent the Andamanese and other Negrito tribes are distinguished by their small stature, microcephalic crania, and low state of intelligence. It is not unlikely that these people may in the early unwritten periods of human history have had in their respective continents a much wider range of distribution than at present, and have been gradually pushed southwards into their present restricted areas by the advance of the races, more powerful in both intellectual and physical development, which we see around them. If in their displacement they failed to mix with their invaders their physical characters would remain pure. For isolation and interbreeding carried on through many centuries would necessarily preserve and even intensify the characteristic structural peculiarities of each race.

PLATE I.

PLATE I.

Fig. 1. Facial view of the skull of a Bushman from the mountain district at the source of the Umzimkulu river; one-half natural size (Table I.).

Fig. 2. Profile view of the same skull; one-half natural size.

Fig. 3. Vertex view of the same skull; one-fourth natural size.

Fig. 4. Base and inner wall of the orbit of the same Bush skull, showing a direct articulation between the orbital plates of the maxillary and frontal bones.

E., Os planum of ethmoid.
L., Lachrymal.
Mx., Orbital plate of superior maxilla.
F., Frontal.
M., Malar bone.

Fig. 5. Facial view of the skull of the Fuegian D. (Table II.); one-half natural size.

Fig. 6. Profile view of the same skull.

Fig. 5.

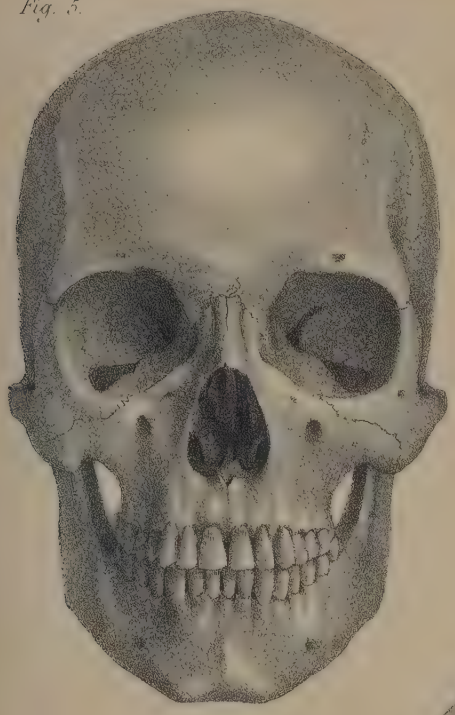


Fig. 6

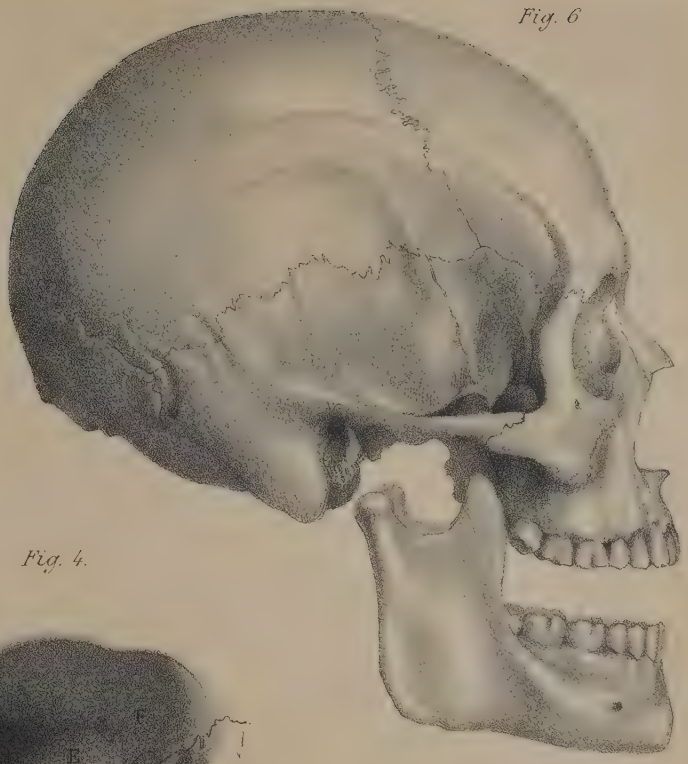


Fig. 4.

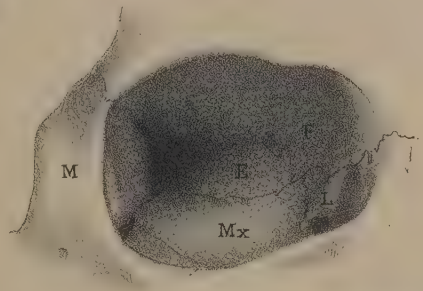


Fig. 2.

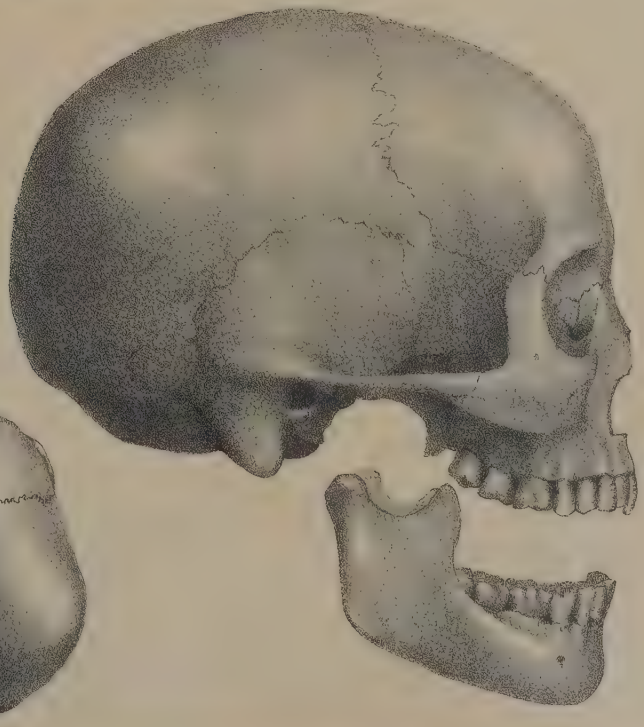


Fig. 1.

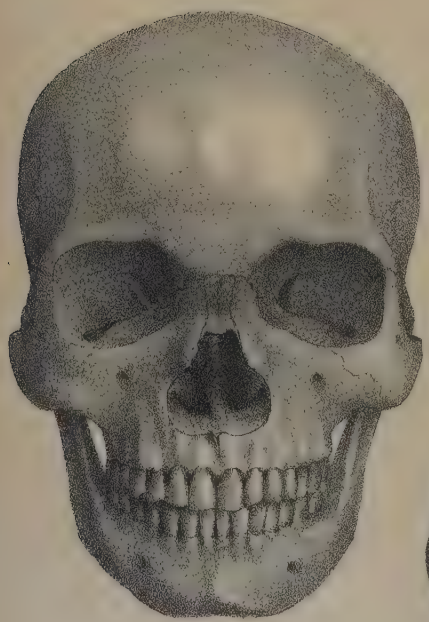


Fig. 3.

FIGS 1-4, BUSHMAN. FIGS 5 & 6, FUEGIAN.

PLATE II.

PLATE II.

Fig. 1. Facial view of the Australian skull from Riverina, New South Wales (Table III.).

Fig. 2. Profile view of the same skull.

Fig. 3. Facial view of the Australian skull from Roebuck Bay (Table IV.).

Fig. 4. Profile view of the dolicho-platycephalic skull, No. 1 from Gipps Land, Victoria (Table V.).

The whole of the Figures in this Plate are one-half natural size.

Fig. 1.

Fig. 2.

Fig. 4.

Fig. 3.

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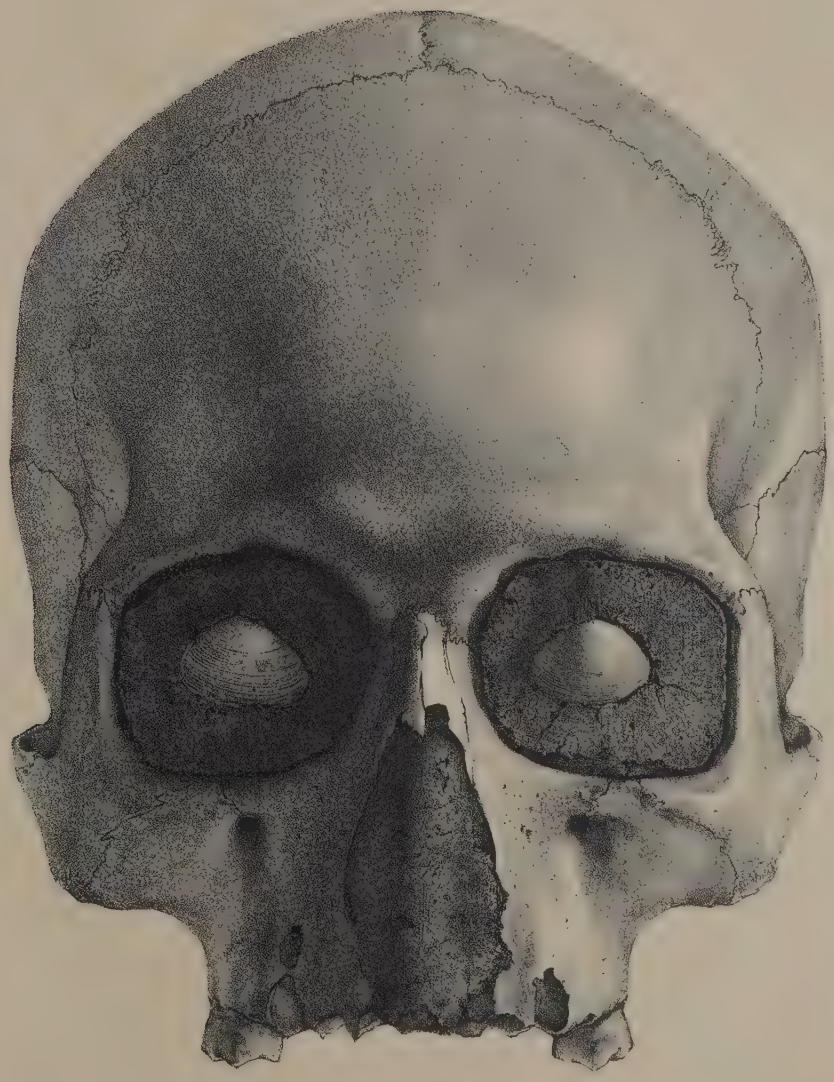
AUSTRALIANS.

PLATE III.

PLATE III.

Facial view of the artificially prepared skull of the Admiralty Islander D. (Table VIII.). In this skull a suture extended from the infraorbital foramen into the floor of the orbit. Natural size.



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ADMIRALTY ISLANDER.

PLATE IV.

PLATE IV.

Fig. 1. Profile view of the skull of the Admiralty Islander A. (Table VIII.); one-half natural size.

Fig. 2. Facial view of the skull of the Admiralty Islander C. (Table VIII.); one-half natural size.

Fig. 3. Nasal region of the Admiralty Islander in which the nasal bones were apparently absent E. (Table VIII.). In this skull a suture extended from the infra-orbital foramen into the floor of the orbit. Natural size.

Fig. 4. Profile view of the skull of the Admiralty Islander K. (Table VIII.), showing the division of the right parietal bone into an upper and a lower portion.

Fig. 4.

Fig. 3.

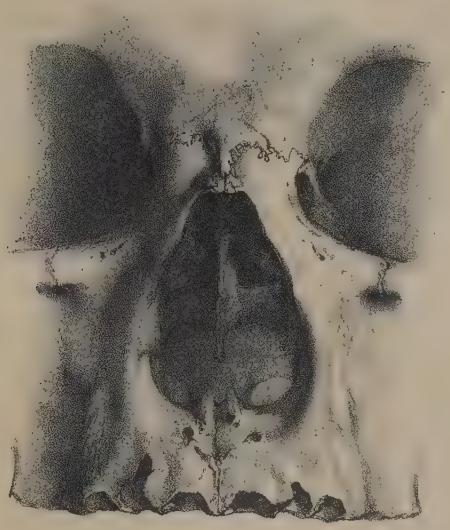
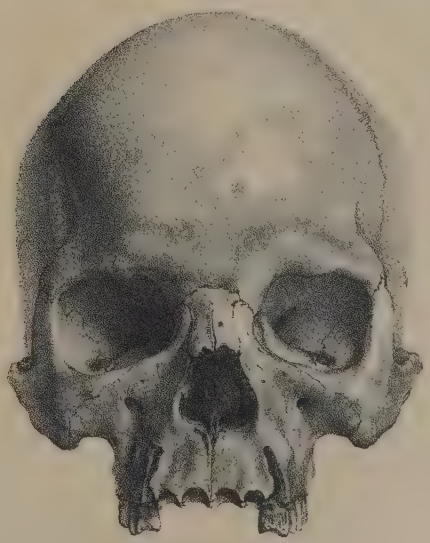


Fig. 1.

Fig. 2.



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ADMIRALTY ISLANDERS.

PLATE V.

PLATE V.

Fig. 1. Occipital view of the skull of the Admiralty Islander A. (Table VIII.).

Fig. 2. Vertex view of the same skull.

Fig. 3. Profile view of the skull of a Hawaian from Waimea Plains (Table IX.).

Fig. 4. Facial view of the same skull.

All the Figures in this Plate are one-half natural size.

Fig. 4.

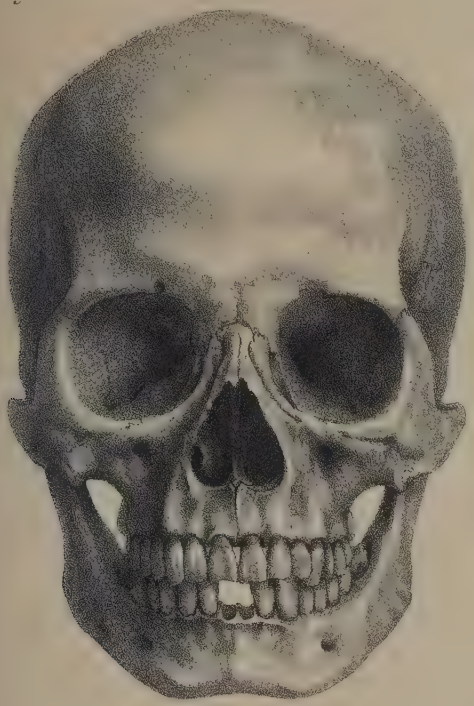


Fig. 3.

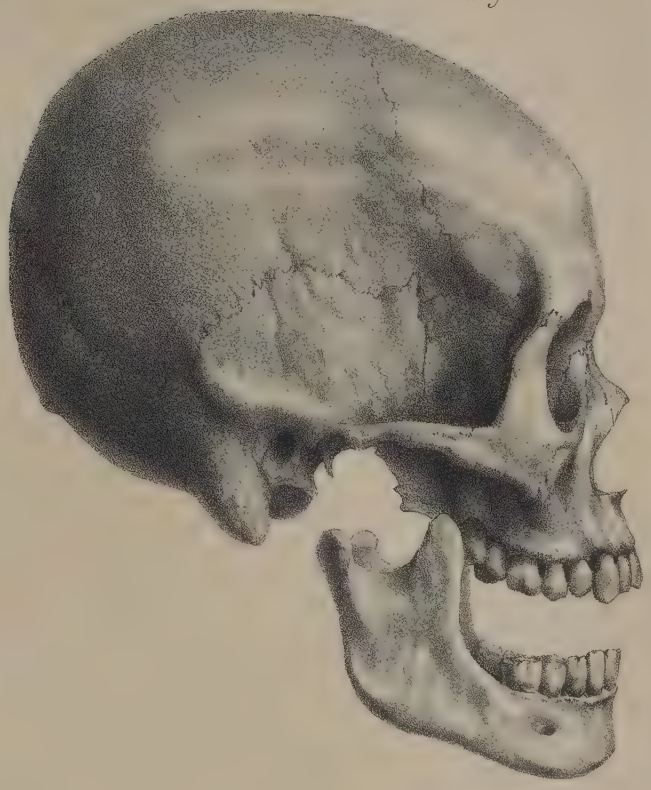
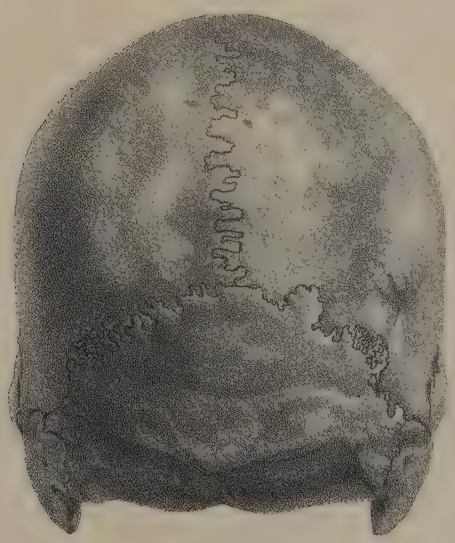


Fig. 2.

Fig. 1.



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FIGS 1 & 2, ADMIRALTY ISLANDER. FIGS 3 & 4, SANDWICH ISLANDER, (Waimea)

PLATE VI.

PLATE VI.

oc., basi-occipital radius.
l., basi-lambdoidal radius.
p., perpendicular radius.
br., basi-bregmatic radius.
g., basi-glabellar radius.

s., plane of dorsum sellæ.
os., basi-occipito-sphenoid axis.
cr., axis of cribriform plate.
sm., spheno-maxillary line.

Mesial antero-posterior sections of the following crania:—

Fig. 1. Bushman from Umzimkulu (Table I.).

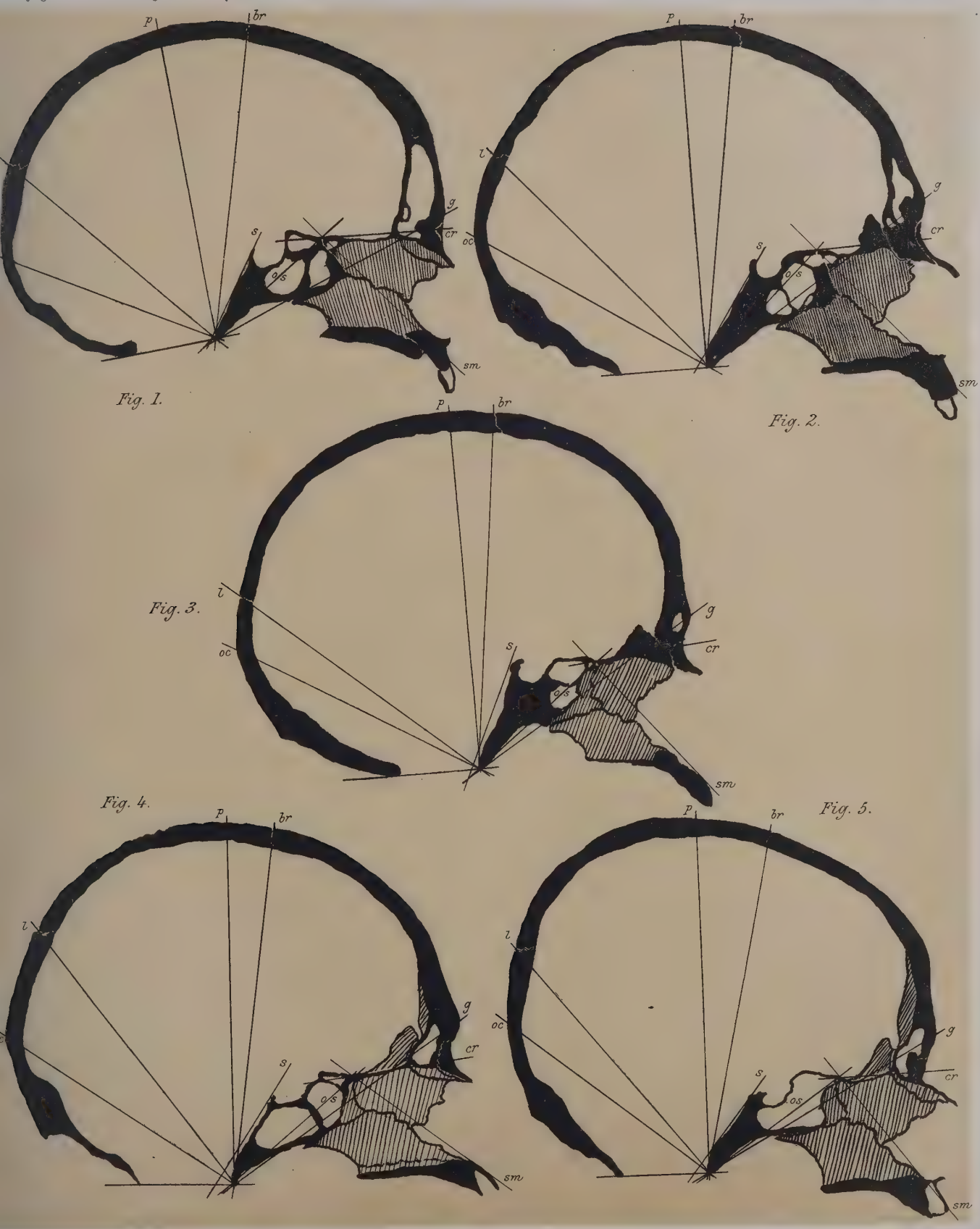
Fig. 2. Fuegian D. (Table II.).

Fig. 3. Admiralty Islander A. (Table VIII.).

Fig. 4. Oahuan D. (Table XI.).

Fig. 5. Hawaian A. (Table IX.).

All the Figures in this Plate are one-half natural size.



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F. Huth, Lith^r Edin^r

Fig. 1, BUSHMAN. Fig. 2, FUEGIAN. Fig. 3, ADMIRALTY ISLANDER.

Fig. 4, OAHUAN. Fig. 5, HAWAIAN.

PLATE VII.

PLATE VII.

oc., basi-occipital radius.
l., basi-lambdoidal radius.
p., perpendicular radius.
br., basi-bregmatic radius.
g., basi-glabellar radius.

s., plane of dorsum sellæ.
os., basi-occipito-sphenoid axis.
cr., axis of cribriform plate.
sm., spheno-maxillary line.

Similar sections of the following crania:—

Fig. 6. Waikato, New Zealander (Table XIV.).

Fig. 7. Chatham Islander (Table XIII.).

Fig. 8. Australian.

Fig. 9. Australian from Gipps Land (Table V.).

Fig. 10. Australian from Queensland (Table III.).

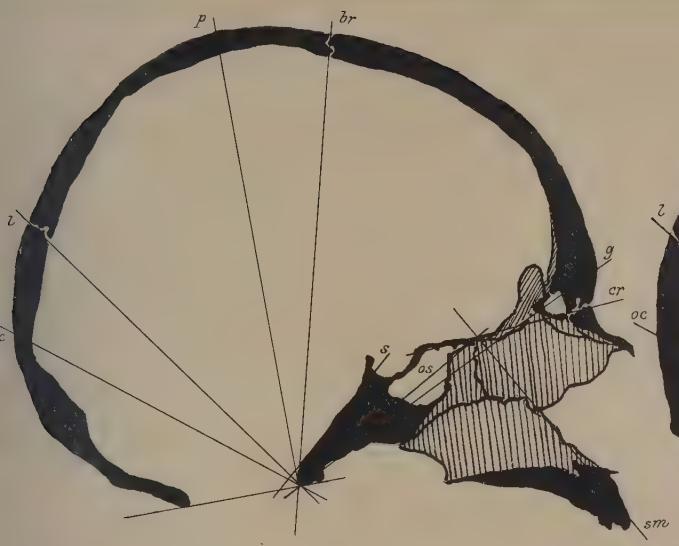

Fig. 6

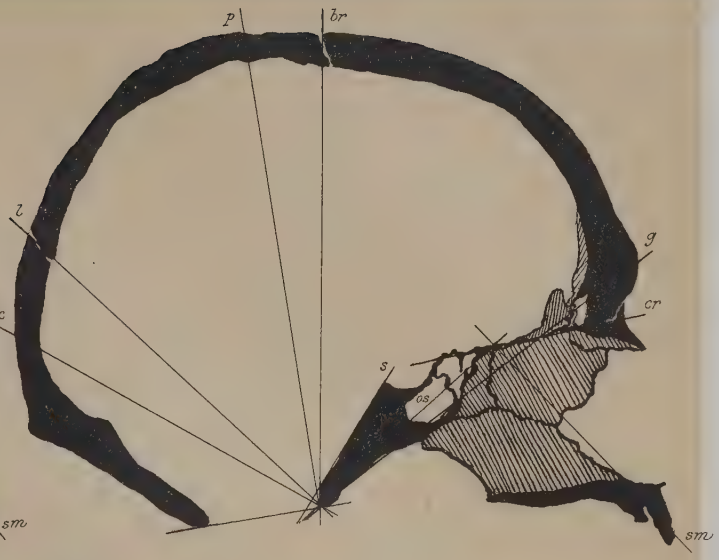

Fig. 7.

Fig. 8.

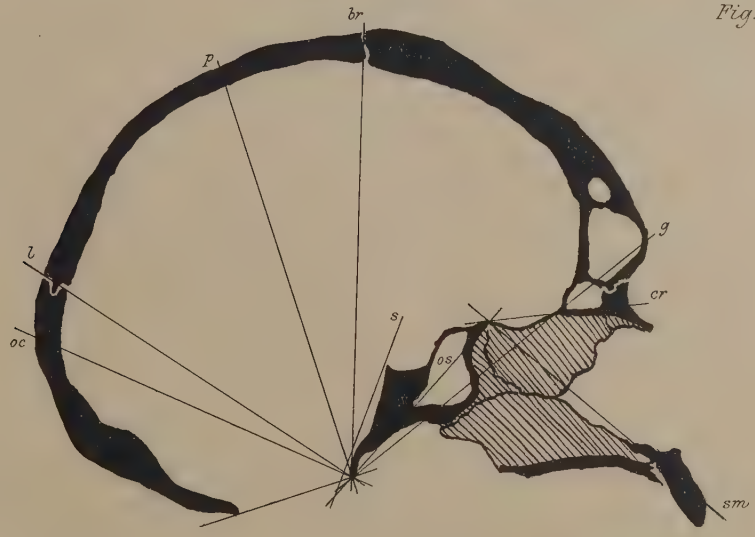

Fig. 9.

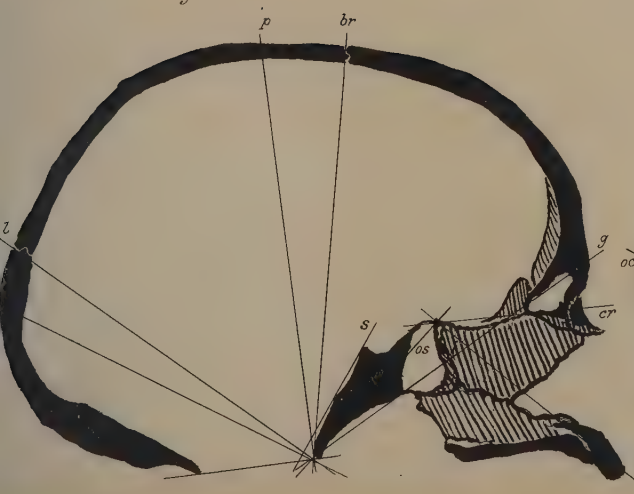

Fig. 10.

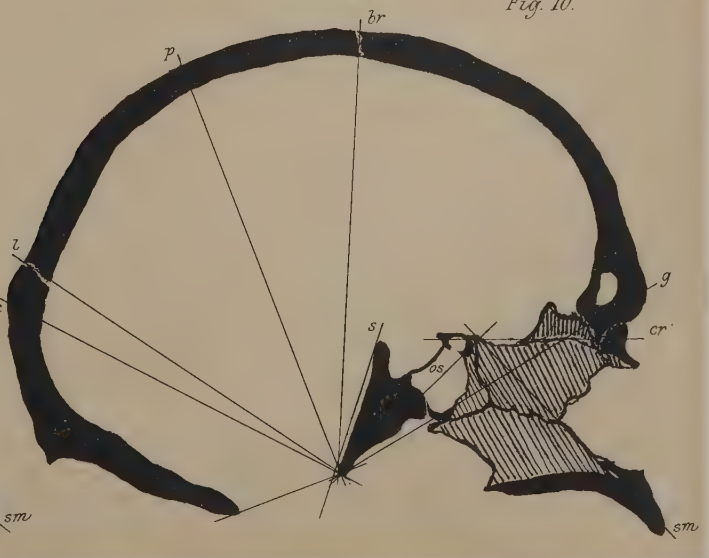

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Fig 6, NEW ZEALANDER. Fig 7, CHATHAM ISLANDER. Fig. 8, AUSTRALIAN.
Fig. 9, GIPPS LAND, AUSTRALIAN. Fig. 10, QUEENSLAND, AUSTRALIAN.

REPORT

ON THE

SCIENTIFIC RESULTS

OF THE

VOYAGE OF H.M.S. CHALLENGER

DURING THE YEARS 1873-76

UNDER THE COMMAND OF

CAPTAIN GEORGE S. NARES, R.N., F.R.S.

AND

CAPTAIN FRANK TOURLE THOMSON, R.N.

PREPARED UNDER THE SUPERINTENDENCE OF

THE LATE

Sir C. WYVILLE THOMSON, Knt., F.R.S., &c.

REGIUS PROFESSOR OF NATURAL HISTORY IN THE UNIVERSITY OF EDINBURGH

DIRECTOR OF THE CIVILIAN SCIENTIFIC STAFF ON BOARD

AND NOW OF

JOHN MURRAY

ONE OF THE NATURALISTS OF THE EXPEDITION

ZOOLOGY—VOL. X.

PART XXX.—REPORT ON THE POLYZOA—THE CHEILOSTOMATA

BY GEORGE BUSK, F.R.S., V.P.L.S., &c.

Published by Order of Her Majesty's Government

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EDITORIAL NOTE.

Shortly after the return of the Expedition to England, George Busk, Esq., F.R.S., consented to prepare a Report on the collection of Polyzoa.

The present Memoir is the first instalment of the Report, and treats of the Cheilostomata. The Manuscript was received in batches between the 7th February 1883 and the 16th July 1884. Mr. Busk promises the second and concluding part of his Report in the course of a few months.

John Murray.

Challenger Office, 32 Queen Street,
Edinburgh, 24*th September* 1884.

ERRATA.

Report on the Polyzoa (Part XXX.).

Page 4, line 3 from top, *for* "*Tubalipora*" *read* "*Tubulipora*."
Page 29, line 13 from foot, *for* "*Cabarea*" *read* "*Caberea*."
Page 34, line 4 from top, *for* "*spatulata*" *read* "*pectogemma*."
Page 35, line 8 from top, *for* "*spatulata*" *read* "*pectogemma*."
Page 165, line 9 from foot, *for* "Oberoligacäns" *read* "Oberoligocäns."
Page 165, line 8 from foot, *for* "Castracaro" *read* "Castrocaro."
Page 168, line 9 from foot, *for* "*Forficala*" *read* "*Forficula*."
Page 194, line 16 from top, *insert* "Pl. XXX. fig. 2."
Page 195, line 3 from foot, *insert* "Pl. XXXV. fig. 19."
Plate II. fig. 4, *for* "*cirratæ*" *read* "*cirrata*."
Plate XXXII. fig. 3, *for* "*Calymophora*" *read* "*Calymmophora*."

THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY.

REPORT on the Polyzoa collected by H.M.S. Challenger during the years 1873–76. By George Busk, F.R.S., V.P.L.S., &c.

PART I.—THE CHEILOSTOMATA.

INTRODUCTION.

When at Sir Wyville Thomson's request I undertook the description of the Polyzoa collected on the Voyage of the Challenger, I had formed no idea of the extent of the task I had imposed on myself, nor of the time, amidst other engagements, that would be required for its due execution, which I can only regret has been so protracted.

One result of the delay in publication has necessarily been to diminish to a considerable extent the originality of my Report, as regards the introduction of new species.

More especially during the last eight or nine years the number of workers in all parts of the world in the subject of the Marine Polyzoa has been much increased, with, of course, a corresponding addition to the number of new species. As amongst these there are many that I had previously noticed in the Challenger Collection, and to which, in the progress of my work, I had assigned names, which were unfortunately appended to the Plates as they were printed off, it became necessary to make the numerous changes of nomenclature which will be noticed in the Explanations of the Plates.

I have endeavoured as much as possible to keep pace with the rapid additions of new species for which science has been indebted to various observers, amongst whom more particularly should be mentioned the Rev. T. Hincks, Mr. P. H. Macgillivray, Mr. J. B. Wilson, and Mr. Goldstein and others. But with the utmost desire to do full justice to priority of publication, numerous omissions will, I fear, be observed, in extenuation of which I can only plead either complete oversight or the circumstance that in many cases I have not found it possible to identify with certainty the species intended from the published figures and descriptions, in the absence of specimens. This remark applies more especially to certain more or less well-marked natural groups or families in which the common characters, so to speak, are so strongly marked as in some cases to mask the more minute specific features. Amongst these groups may be noticed more particularly the Reteporidæ, Salicornariadæ, Celleporidæ, and Adeoneæ, amongst which, as well as in many other of the provisional or artificial escharan genera, are numerous forms which cannot be distinguished with certainty in the absence of the characters afforded by the chitinous parts.

The number of species of CHEILOSTOMATA contained in the Challenger Collection, so far as I have been able to determine them, is about two hundred and eighty-six, of which, at the time when the collection came into my hands seven years ago, no less than one hundred and eighty appeared to be new, or were unrecognisable by me.

Nor is this large proportion of new species much to be wondered at, seeing the peculiar conditions, especially as to depth of water and distance from land, under which the majority of the Challenger's dredgings and trawlings were made.

Though more or less visible throughout the greater part of the collection, the difference between a collection of Polyzoa made in deep water or at a distance from shore, and one made in the same geographical region near the shore, or in shallow water, is in no case so strongly exemplified as in that of the almost exclusively Australian genus *Catenicella*.

On the voyage of H.M.S. "Rattlesnake," employed in a surveying expedition on the coast of Australia and the neighbouring islands, the collections were of course chiefly made near the shore or in soundings of a moderate depth. On that expedition Mr. J. Macgillivray collected no less than seventeen or eighteen species of the genus, to which, either from Australia or New Zealand, about as many more have since been added, so that the number of known species of *Catenicella* living in comparatively shallow water may be roughly estimated at between thirty and forty; all with two or three exceptions peculiar to the Australian region.

Belonging to this genus the Challenger Collection contains eight species, seven of which only were procured in the Australian region at depths varying from 30 to 120 fathoms, and from closely contiguous Stations. An eighth, and the only new species, was obtained in the South Atlantic region off the coast of Brazil, where the depth is recorded as 350 fathoms.

Classification.

As to the scheme of classification followed in this Report, and set forth in the subjoined Table on pages xxii, xxiii, it is scarcely necessary to remark that it has no pretension to be regarded as more than a convenient, and, to a considerable degree, artificial arrangement, like all others that have been proposed. For although many of the family groups may in some measure be regarded as expressing natural alliances, many of them, more especially in the Subdivision C., or Escharina, can only be considered as artificial, and as such they must perhaps remain until we are better acquainted with the true significance of the minute parts or organs upon which the distinctive characters are in many cases founded. Nor at present, perhaps, are we in a position fully to appreciate the relative value of the *zoœcial* as compared with the *zoarial* characters, which of late it appears to be the fashion, unduly as I think, to depreciate; the individuality of the zoarium as a continuous whole or entity having been too much overlooked in the almost exclusive consideration of its component parts or segments.

Nevertheless, in order to place myself as far as possible in accord with modern views, I have, in the heterogeneous Family Escharidæ more especially, adopted partially the nomenclature proposed by Mr. Hincks and Prof. Smitt, but in doing this I have found it impossible to avoid a certain amount of the confusion necessarily incidental to an attempt to graft a new system upon an old one, based on a different set of characters.

Geographical and Bathymetrical Distribution.

With respect to the geographical distribution of the species enumerated in the Report, I have thought it convenient to divide the oceans traversed by the Challenger into seven regions, distinguished by the letters A, B, C, D, E, F, G; three being to the north and four to the south of the equator, each including 90° of longitude, as shown in the accompanying map, in which also are marked the Stations from which any Polyzoa were obtained.

A. North Atlantic Region, between the parallels of 70° W. and 20° E.[1]
B. South Atlantic Region, from 70° W. to 20° E.
C. South Indian or Kerguelen Region, from 20° to 110° E.
D. Australian Region, from 110° E. to 160° W. and S.
E. Philippine or Japanese Region, from 110° E. to 160° W. and N.
F. North Pacific Region, from 160° W. to the west coast of North America.
G. South Pacific, from 160° to 70° W.

In the following List the Stations in each geographical region are arranged in bathymetrical order, beginning with those of the greatest depth. To the names of the

[1] One Station, viz., 44, is 71° 40′ W.

species procured at each Station a reference is added, by corresponding letters, to the other regions in which the same species occurred, so that its geographical distribution might be seen at a glance, and at the same time it will be observed that the extent of geographical distribution is to a considerable degree correlative with the bathymetrical, the wider distribution being in most instances coincident with the shallower depths; though to this there are some striking exceptions.

A.—NORTH ATLANTIC REGION.

STATION 64, lat. 35° 35′ N., long. 50° 27′ W.; 2750 fathoms (?); red clay.

Farciminaria delicatissima.

STATION 101, lat. 5° 48′ N., long. 14° 20′ W.; 2500 fathoms; blue mud.

Bugula reticulata, var. *unicornis.*

STATION 104, lat. 2° 25′ N., long. 20° 1′ W.; 2500 fathoms; Globigerina ooze.

Bugula reticulata, var. *unicornis.*

STATION 89, lat. 22° 18′ N., long. 22° 2′ W.; 2400 fathoms; Globigerina ooze.

Bugula mirabilis. | *Farciminaria delicatissima.*

STATION 68, lat. 38° 3′ N., long. 39° 19′ W.; 2175 fathoms; Globigerina ooze.

Farciminaria delicatissima. | *Bugula reticulata*, var. *unicornis.*
Bifaxaria reticulata.

STATION 14, lat. 21° 1′ N., long. 46° 29′ W.; 1950 fathoms; Globigerina ooze.

Farciminaria delicatissima.

STATION 13, lat. 21° 38′ N., long. 44° 39′ W.; 1900 fathoms; Globigerina ooze.

Farciminaria delicatissima. | *Salicornaria magnifica*, B, C.
Bifaxaria reticulata. | *Tessaradoma boreale.*

STATION 106, lat. 1° 47′ N., long. 24° 26′ W.; 1850 fathoms; Globigerina ooze.

Bugula reticulata, var. *unicornis.* | *Farciminaria delicatissima.*

Station 44, lat. 37° 25′ N., long. 71° 40′ W.; 1700 fathoms; blue mud.

Canda simplex.

Station 70, lat. 38° 25′ N., long. 35° 50′ W.; 1675 fathoms; Globigerina ooze.

Menipea clausa. | *Farciminaria gracilis*, B.

Bifaxaria minuta.

Station 87, lat. 25° 49′ N., long. 20° 12′ W.; 1675 fathoms; rock.

Nellia simplex.

Station 3, lat. 25° 45′ N., long. 20° 14′ W.; 1525 fathoms; hard ground.

Bugula leontodon.

Station VI., lat. 36° 23′ N., long. 11° 18′ W.; 1525 fathoms; Globigerina ooze.

Kinetoskias cyathus, B.

Cape Verde Islands, lat. 17° 12′ N., long. 24° 55′ W.; 1070 to 1150 fathoms; volcanic mud.

Scrupocellaria macandrei.

Station 76, lat. 38° 11′ N., long. 27° 9′ W.; 900 fathoms; Pteropod ooze.

Cellularia biloba. | *Carbasea pedunculata.*

Station 23, lat. 18° 24′ N., long. 63° 28′ W., off Sombrero Islands; 450 fathoms; Pteropod ooze.

Brettia cornigera. | *Pasythea eburnea*, B.

Bugula versicolor, B. | *Farciminaria atlantica.*

Tessaradoma boreale.

Station 75, lat. 38° 38′ N., long. 28° 28′ W.; 450 fathoms; volcanic mud.

Hippothoa divaricata, C. | *Retepora atlantica.*

Carbasea pedunculata. | *Cribrilina radiata.*

Membranipora albida, D. | *Flustramorpha hastigera.*

Membranipora galeata, var. *multifida*, B. | *Smittia oratavensis.*

Micropora coriacea. | *Mucronella canalifera.*

Retepora imperati. | *Adeonella distoma.*

Cellepora ansata.

Cellepora ovalis.

Station 24, lat. 18° 38′ N., long. 65° 5′ W., off Culebra Island; 390 fathoms; Pteropod ooze.

Pasythea eburnea, B. | *Farciminaria atlantica.*

Cape Verde Islands, 100 to 120 fathoms.

Retepora imperati. | *Smittia jacobensis.*
Porella lævis, var. *subcompressa.*

Station 48, lat. 43° 4′ N., long. 64° 5′ W.; 51 fathoms; rock.

Eschara elegantula. | *Cellepora canaliculata.*

Station 36, lat. 32° 7′ N., long. 65° 4′ W., off Bermuda; 30 fathoms; coral.

Ætea anguina, C, D, G. | *Bugula neritina.*

Cape Verde Islands, 10 fathoms.

Diachoris hirtissima. | *Cupularia owenii.*

Station 109, lat. 0° 55′ N., long. 29° 22′ W., off St. Paul's Rocks; shallow water.

Catenaria diaphana. | *Scrupocellaria macandrei.*
Tubucellaria opuntioides.

B.—SOUTH ATLANTIC REGION.

Station 325, lat. 36° 44′ S., long. 46° 16′ W.; 2650 fathoms; blue mud.

Cellularia crateriformis. | *Kinetoskias cyathus*, A.
Farciminaria magna, C.

Station 332, lat. 37° 29′ S., long. 27° 31′ W.; 2200 fathoms; Globigerina ooze.

Bicellaria naviculariis. | *Bugula margaritifera.*

Station 323, lat. 35° 39′ S., long. 50° 47′ W.; 1900 fathoms; blue mud.

Cellularia crateriformis. | *Farciminaria cribraria.*
Bugula margaritifera. | *Farciminaria magna*, var. *armata.*
Salicornaria magnifica, A, C.

Station 320, lat. 37° 17′ S., long. 53° 52′ W.; 600 fathoms; green sand.

Caberea crassimarginata.
Bugula reticulata, C, G.
Ichthyaria oculata.
Membranipora galeata, var. *erecta*, A.
Foveolaria elliptica, D.
Foveolaria falcifera.
Vincularia labiata.
Bifaxaria denticulata.
Salicornaria dubia.
Melicerita atlantica.
Melicerita dubia.
Retepora magellensis.
Turritigera stellata.
Cribrilina latimarginata.
Smittia smittiana.
Myriozoum immersum.
Myriozoum simplex.
Cellepora rudis.

Station 135, lat. 37° 1′ S., long. 12° 19′ W., Tristan da Cunha Islands; 360 fathoms; volcanic sand.

Ætea anguina, A, D, G.
Hippothoa divaricata, A.
Catenicella elegans, D.
Scrupocellaria pilosa.
Caberea darwinii, C.
Membranipora crassimarginata, var. *incrustans.*
Micropora uncifera.
Micropora coriacea, A.
Cribrilina radiata, A.
Microporella ciliata.
Microporella malusii.
Lepralia incisa.
Chorizopora hyalina, var. *bougainvillei*, C.
Aspidostoma giganteum.
Schizoporella auriculata, var. *alba.*
Schizoporella circinata.
Haswellia auriculata.
Adeonella atlantica.
Cellepora tubulosa.

Station 122, lat. 9° 5′ S., long. 34° 50′ W., off Barra Grande, Brazil; 350 fathoms; red mud.

Pasythea eburnea, A.
Catenicella sacculata.
Catenicella elegans, D.
Bicellaria navicularis.
Bugula versicolor, A.
Kinetoskias pocillum, G.
Farciminaria brasiliensis.
Farciminaria gracilis, A.
Bifaxaria submucronata.
Bifaxaria corrugata.
Salicornaria magnifica, A, C.
Mucronella castanea.
Adeonella distoma, var. *imperforata.*
Cellepora aspera.

Station 142, lat. 35° 4′ S., long. 18° 37′ E.; 150 fathoms; green sand.

Menipea marionensis, C.
Caberea darwinii, C.
Retepora tessellata, var. *pubens*.
Turritigera stellata.
Flustramorpha marginata, C.
Schizoporella nivea.
Schizoporella elegans.
Gephyrophora polymorpha.
Haswellia auriculata.
Adeonella regularis.
Cellepora cylindriformis.

Station 314, lat. 51° 35′ S., long. 65° 39′ W.; 70 fathoms; sand.

Menipea benemunita, C, G.
Menipea aculeata, G.
Menipea flagellifera, C.
Ichthyaria oculata.
Carbasea elegans, D.
Salicornaria variabilis, C, G.
Salicornaria tenuirostris.
Cellepora bicornis, C.

Station 313, lat. 52° 20′ S., long. 67° 39′ W.; 55 fathoms; sand.

Menipea benemunita, C, G.
Menipea flagellifera, C.
Cribrilina monoceros, C, D, F, G.
Smittia marsupialis, F.
Cellepora bicornis, C.

Off Bahia; 10 to 40 fathoms.

Nellia oculata, C, D, E.
Bicellaria glabra.
Smittia tenuis.
Mucronella castanea.
Gemellipora glabra.
Cellepora imbellis.
Cellepora mamillata, var. *atlantica*, C.
Cupularia monotrema.

Simon's Bay, Cape of Good Hope; 18 fathoms.

Menipea flabellum.
Menipea triseriata.
Menipea cirrata.
Membranipora galeata, var. *multifida*, A.
Amphiblestrum imbricatum.
Amphiblestrum capense.
Foveolaria tubigera.
Onchoporella bombycina.
Retepora tessellata.
Retepora tessellata, var. *cæspitosa*.
Retepora lata.
Cribrilina labiosa, var. *fragilis*.
Chorizopora brongniartii.
Mucronella contorta.
Mucronella tricuspis, C.
Schizoporella tenuis, F.
Gemellipora cribritheca.
Cellepora simonensis.
Cellepora conica.

Station 315, lat. 51° 40′ S., long. 57° 50′ W.; 12 fathoms; sand and gravel.

Menipea benemunita, C, G.
Menipea aculeata, G.
Caberea minima.
Carbasea ovoidea, C, G.
Diachoris magellanica, D.
Diachoris costata.
Salicornaria malvinensis, C, D, G.
Cribrilina monoceros, C, D, F, G.
Microporella malusii.
Lepralia margaritifera.
Lepralia marsupium.
Chorizopora hyalina, var. *bougainvillei*, C.
Smittia stigmatophora.
Mucronella tricuspis, C.
Cellepora eatonensis, C, G.

Port William, Falkland Islands; 5 to 10 fathoms.

Carbasea ovoidea, C, G. | *Salicornaria malvinensis*, C, D, G.

C.—SOUTH INDIAN OR KERGUELEN REGION.

Station 156, lat. 62° 26′ S., long. 95° 44′ E.; 1975 fathoms; Diatom ooze.

Bicellaria infundibulata.

Station 157, lat. 53° 55′ S., long. 108° 35′ E.; 1950 fathoms; Diatom ooze.

Bugula bicornis. | *Salicornaria magnifica*, A, B.
Onchopora sinclairii.

Station 153, lat. 65° 42′ S., long. 79° 49′ E.; 1675 fathoms; blue mud.

Farciminaria magna, B.

Station 147, lat. 46° 16′ S., long. 48° 27′ E.; 1600 fathoms; Diatom ooze.

Bicellaria infundibulata. | *Bugula reticulata*, B, G.
Foveolaria orbicularis.

Station 148, lat. 46° 47′ S., long. 51° 37′ E., off Possession Island; 210 fathoms; hard ground, gravel, shells.

Nellia oculata, B, D, E.
Caberea darwinii, B.
Retepora gigantea.
Retepora cavernosa.
Reteporella myriozoides.
Escharoides occlusa, D, E.
Smittia graciosa.
Mucronella ventricosa, var. *multispinata.*
Myriozoum marionense.
Cellepora vagans.
Cellepora mamillata, var. *atlantica*, B.
Schizoporella elegans, B.

Station 150, lat. 52° 4′ S., 71° 22′ E.; 150 fathoms; coarse gravel.

Bicellaria pectogemma.
Membranipora galeata, var. *furcata.*
Onchopora sinclairii.
Cellepora bicornis, B.

Station 145, lat. 46° 43′ S., long. 38° 4′ E.; 140 fathoms; volcanic sand.

Bicellaria pectogemma.
Farciminaria hexagona.

Prince Edward Island; 80 to 150 fathoms.

Caberea darwinii, B.
Bugula sinuosa.
Carbasea ovoidea, B, G.
Vincularia gothica.
Electra cylindracea.
Salicornaria clavata, D, G.
Smittia marionensis.
Mucronella rostrigera.
Mucronella tricuspis, B.
Mucronella ventricosa, var. *multispinata.*
Myriozoum marionense.
Cellepora bicornis, B.

Station 151, lat. 52° 59′ S., long. 73° 33′ E., off Heard Island; 75 fathoms; volcanic mud.

Hippothoa flagellum.
Catenaria attenuata.
Cellularia quadrata.
Nellia oculata, B, D, E.
Bicellaria pectogemma.
Bugula longissima.
Diachoris magellanica, var. *distans.*
Membranipora crassimarginata, var. *erecta*, D.
Vincularia gothica, var. *granulata.*
Salicornaria clavata, D, G.
Onchopora sinclairii.
Reteporella flabellata.
Cribrilina philomela, var. *adnata.*
Escharoides verruculata.
Schizoporella triangula, D.
Myriozoum marionense.
Cellepora albirostris.

Station 144a, lat. 46° 48′ N., long. 37° 49′ E., Marion Island; 69 fathoms; volcanic sand.

Menipea flagellifera, B.
Menipea marionensis, B.
Caberea darwinii, B.
Carbasea ovoidea, B, G.
Membranipora galeata, var. *furcata.*
Salicornaria malvinensis, B, D, G.
Cribrilina philomela.
Cribrilina philomela, var. *adnata.*
Cribrilina monoceros, B, D, F, G.
Flustramorpha marginata, B.
Smittia jacobensis, A.
Schizoporella marsupifera, D.
Myriozoum marionense.
Cellepora pustulata, D.
Cellepora bicornis, B.

STATION 149, lat. 49° 8′ S., long. 70° 12′ E.; Kerguelen Islands; 20 fathoms; volcanic mud.

Cellularia quadrata.
Cellularia elongata.
Menipea benemunita, B, G.
Menipea flagellifera, B.
Caberea darwinii, B.
Bugula longissima.
Flustra crassa.
Carbasea ovoidea, B, G.
Diachoris inermis.
Membranipora galeata.
Amphiblestrum cristatum.
Salicornaria clavata, D, G.
Salicornaria variabilis, B, G.
Salicornaria malvinensis, B, D, G.
Onchopora sinclairii.
Chorizopora hyalina, var. *bougainvillei*, B.
Smittia marionensis.
Cellepora eatonensis, B, G.

D.—AUSTRALIAN REGION.

STATION 160, lat. 42° 42′ S., long. 134° 10′ E.; 2600 fathoms; red clay.

Cellepora solida.

STATION 176, lat. 18° 30′ S., long. 173° 52′ E.; 1450 fathoms; Globigerina ooze.

Salicornaria malvinensis, B, C, G.
Retepora margaritacea.

STATION 195, 4° 21′ S., long. 129° 7′ E.; 1425 fathoms; blue mud.

Cellularia cirrata.
Farciminaria hexagona, C.

STATION 196, lat. 0° 48′ S., long. 126° 58′ E.; 825 fathoms; hard ground.

Brettia australis.
Bicellaria bella.
Bicellaria moluccensis.
Bicellaria macilenta.
Farciminaria hexagona, C.
Flustra biseriata, G.
Carbasea dissimilis.
Bifaxaria papillata.
Siphonicytara serrulata.

STATION 170, lat. 29° 55′ S., long. 178° 14′ W., off Kermadec Islands; 520 fathoms; volcanic mud.

Carbasea moseleyi.

Station 167, lat. 39° 32′ S., long. 171° 48′ E.; 150 fathoms; blue mud.

Caberea rostrata.
Schizoporella marsupifera, C.
Cellepora pustulata, C.

Station 163A, lat. 36° 59′ S., long. 150° 20′ E., off Twofold Bay; 150 fathoms; green mud.

Eucratea chelata.
Catenicella ventricosa.
Catenicella hastata.
Catenicella plagiostoma.
Catenicella elegans, B.
Didymia simplex.
Dimetopia cornuta.
Flustra denticulata.
Carbasea dissimilis.
Membranipora spinosa.
Amphiblestrum umbonatum.
Calymmophora lucida.
Salicornaria divaricata.
Salicornaria bicornis.
Tubucellaria hirsuta.
Smittia transversa.
Adeona appendiculata.

Station 190, lat. 8° 56′ S., long. 136° 5′ E.; 49 fathoms; green mud.

Nellia oculata, B, C, E.
Caberea lata.
Carbasea cribriformis.
Retepora columnifera.
Retepora delicatula.
Eschara gracilis.
Mucronella bisinuata.
Haswellia australiensis.
Adeonella intricaria.

Station 162, lat. 39° 10′ S., long. 146° 37′ E., Bass Strait; 38 fathoms; sand and shells.

Ætea anguina, A, C, G.
Catenicella hastata.
Canda arachnoides.
Flustra membraniporides.
Carbasea dissimilis.
Carbasea elegans, B.
Carbasea pisciformis.
Diachoris crotali.
Membranipora crassimarginata, var. *erecta*, C.
Amphiblestrum cervicorne.
Foveolaria elliptica, B.
Caleschara denticulata, var. *tenuis.*
Salicornaria clavata, C, G.
Salicornaria simplex.
Retepora crassa.
Retepora phœnicea.
Eschara gracilis.
Schizoporella triangula, C.
Cellepora hastigera.
Cellepora columnaris.
Cellepora bidenticulata, var. *subæqualis.*

STATION 163B, lat. 33° 51′ S., long. 151° 22′ E., off Port Jackson; 35 fathoms; hard ground.

Catenicella plagiostoma.
Catenicella umbonata.
Catenicella pulchella.
Flustra membraniporides.
Salicornaria clavata, C, G.
Cribrilina monoceros, B, C, F, G.
Lepralia tuberosa.
Schizoporella jacksoniensis.
Cellepora tuberculata.
Cellepora jacksoniensis.
Cellepora apiculata.
Cellepora bidenticulata.

STATION 161, lat. 38° 22′ S., long. 144° 36′ E., off Port Philip; 33 fathoms; sand.

Ætea anguina, A, C, G.
Catenicella hastata.
Catenicella cribraria.
Cellularia cuspidata.
Emma crystallina.
Caberea rudis.
Carbasea dissimilis.
Retepora crassa.
Retepora victoriensis.
Mucronella pyriformis.
Mucronella simplicissima.
Schizoporella cecilii.
Cellepora bilabiata.
Lunularia capulus.

STATION 188, lat. 9° 59′ S., 139° 42′ E.; 28 fathoms; green mud.

Catenicella elegans, B.
Scrupocellaria ciliata.
Nellia oculata, B, C, E.
Carbasea cribriformis.

STATION 172, lat. 20° 58′ S., long. 175° 9′ W., off Nukalofa, Tongatabu; 18 fathoms; coral mud.

Membranipora albida, A.
Retepora apiculata.
Retepora producta, E.
Mucronella quadrata.

PORT JACKSON; 2 to 10 fathoms; mud.

Diachoris magellanica, B.
Retepora jacksoniensis.

STATION 186, lat. 10° 30′ S., long. 142° 18′ E., off Cape York; 8 fathoms; coral mud.

Chlidonia cordieri.
Caberea lata.
Carbasea cribriformis.
Salicornaria gracilis.
Retepora hirsuta.
Retepora tubulata.
Lepralia celleporoides.
Lepralia dorsiporosa.
Escharoides occlusa, C, E.
Haswellia australiensis.
Adeonella pectinata.
Cellepora discoidea.
Cellepora tridenticulata.
Cupularia guineensis.

ADMIRALTY ISLANDS.

Scrupocellaria securifera. | *Retepora simplex*, E.
Lepralia lonchæa.

E.—PHILIPPINE OR JAPANESE REGION.

STATION 241, lat. 35° 41′ N., long. 157° 42′ E.; 2300 fathoms; red clay.

Farciminaria pacifica.

STATION 214, lat. 4° 33′ N., long. 127° 6′ E.; 500 fathoms; blue mud.

Bifaxaria lævis.

STATION 201, lat. 70° 3′ N., long. 121° 48′ E.; 82 fathoms; stones and gravel.

Adeonella platalea.

COBIE, JAPAN; 8 to 50 fathoms.

Retepora victoriensis, var. *japonica.* | *Lepralia japonica.*

STATION 208, lat. 11° 37′ N., long. 123° 31′ E.; 18 fathoms; blue mud.

Nellia oculata, B, C, D. | *Retepora mucronata.*
Amphiblestrum papillatum. | *Microporella personata.*
Lepralia feegeensis.

STATION 212, lat. 6° 54′ N., long. 122° 18′ E.; 10 fathoms; sand.

Retepora philippinensis.

SAMBOANGAN; 10 fathoms.

Biflustra savartii. | *Escharoides occlusa*, C, D.
Retepora producta, D. | *Adeonella polymorpha.*
Retepora simplex, D. | *Cellepora samboangensis.*

F.—NORTH PACIFIC REGION.

Station 253, lat. 38° 9′ N., long. 156° 25′ W.; 3125 fathoms; red clay.

Bifaxaria abyssicola.
Cribrilina monoceros, B, C, D, G.
Bugula johnstoniæ.[1]
Phylactella, sp.?

Off Honoruru, Sandwich Islands; 20–40 fathoms.

Scrupocellaria ornithorhynchus.
Steganoporella magnilabris.
Retepora denticulata.
Retepora contortuplicata.
Chorizopora honolulensis.
Smittia marsupialis, B.
Mucronella delicatula.
Mucronella magnifica.
Schizoporella furcata.
Schizoporella tenuis.
Myriozoum honolulense.
Cellepora honolulensis.
Cellepora polymorpha.
Cellepora vagans, C.

G.—SOUTH PACIFIC REGION.

Station 299, lat. 33° 31′ S., long. 74° 43′ W.; 2160 fathoms; blue mud.

Menipea pateriformis.
Bugula reticulata, B, C.
Kinetoskias pocillum, B.
Flustra biseriata, D.

Station 280, lat. 18° 40′ S., long. 149° 52′ W.; 1940 fathoms; Globigerina ooze.

Catenaria bicornis.

Station 303, lat. 45° 31′ S., long. 78° 9′ W.; 1325 fathoms; blue mud.

Menipea benemunita, B, C.
Menipea aculeata, B.
Carbasea ovoidea, B, C.
Cribrilina monoceros, B, C, D, F.

Cellepora eatonensis, B, C.

Station 304, lat. 46° 53′ S., long. 75° 12′ W.; 45 fathoms; green sand.

Ætea anguina, A, C, D.
Salicornaria clavata, C, D.
Salicornaria variabilis, B, C.
Salicornaria malvinensis, B, C, D.

Cellepora signata.

Station 312, lat. 53° 37′ S., long. 70° 56′ W.; 9 fathoms; blue mud.

Carbasea ovoidea, B, C.
Schizoporella longispinata.

[1] This and the following species were too fragmentary to permit of complete identification, and have therefore not been included in the text.

Explanation of Terms.

Subjoined are a few notes respecting some of the terms employed in this Report, which may perhaps require explanation either as new or as employed in a particular sense.

I. With respect to the characters presented by the Zoarium, I have employed the word *dimorphous* to express that it may be both erect or free, or decurrent and incrusting, and more or less closely attached.

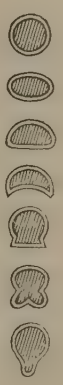
II. With regard to the Zoœcia—

A. The surface may be

1. Smooth.
2. Polished.
3. Granular.
4. Verrucose.
5. Rugose.
6. Pitted.
7. Punctulate, minutely porous.
8. Punctate, with larger perforations.
9. Reticulate.

B. The orifice may be

1. Orbicular.
2. Elliptical.
3. Semiorbicular.
4. Crescentic.
5. Coarctate.
6. Trifoliate.
7. Clithridiate (keyhole-shaped).



C. The lower border may be

1. Entire, sinuous, or straight.
2. Mucronate.
3. Emarginate.
4. Dentate.
5. Bidenticulate.
6. Incised.

D. The peristome may be

1. Thin or thick.
2. Elevated, produced or level.
3. Armed with oral spines, either rigid or articulated
4. Unarmed.

III. Special pores may be present on the front of the zoœcia, and are

1. Lunate—crescentic and usually fimbriated.
2. Simple—circular and either (*a*) *suboral* or *labial*, formed by the constriction of a notch in the lower lip; or (*b*) *central*, independent of the orifice.

IV. The Oœcia may be

1. Erect or recumbent.
2. Front entire, fissured, or punctured.
3. Cucullate—when the front is widely deficient.
4. Stigmate, with a trifoliate or circular bordered mark or space (stigma) in front.

V. Special Organs.—Under this head are included all forms of avicularian and vibracular organs.

A. Avicularia, may be

1. As to form—
   (*a*) Pedunculate and usually articulate.
   (*b*) Sessile.
   (*c*) Immersed.

2. As to function—

(*a*) Prehensile—when the mandible, beak, and muscles are adapted for prehensile purposes.

(*b*) Retentive—when the mandible is thin, membranous, and weak, and adapted merely to serve as a lid to the cup or receptacle.

3. As to position—

(*a*) Vicarious—when they represent or replace an ordinary zoœcium.

(*b*) Adventitious—when either attached to some part or other of a zoœcium or interspersed among the zoœcia.

B. Vibracula, of which two varieties may be distinguished—

1. Simple—consisting of a basal cup, without a beak, to which the *seta* or *flagellum* is articulated, usually by a double joint, admitting of motion in only one plane.
2. Compound—in which the seta is continuous with or articulated to a basal mandibular portion, and the cup or receptacle has a more or less distinct beak.

VI. Chitinous Elements.—As will be seen in the Report, I have in several families largely resorted to the chitinous elements of the skeleton for diagnostic characters, for which purpose it is in many cases impossible to over-rate the value of these parts, as I have attempted partially to show in another place,[1] and further study has only convinced me that their importance extends far beyond the mere distinction of genera and species. But to render this manifest it would be necessary to embrace many forms besides those contained in the Challenger collection, and I am not as yet prepared to go fully into the subject, even were this the proper place.

The chitinous elements here principally intended, are the so-termed *opercula* or *oral valves* and the chitinous parts of the avicularia and vibracula, that is to say, the *mandibles* and *setæ* or *flagella*.

A. Opercula.—Although there are one or two forms which must be ranged under the Cheilostomata, in which the existence of a distinct operculum or articulated lid to the orifice cannot be detected, such an appendage in some form or another may be regarded as an all but universal characteristic of the sub-order.

The infinite variety in form and structure, and mode of muscular attachment of the opercula, is very remarkable, as is also the constancy of the characters presented by them in the different species, genera, and families.

1. *Form.*—They are all more or less circular or semicircular in outline, with the lower border either straight or sinuated, or forming the segment of a smaller circle than the upper part, or by a further constriction produced in the middle into a narrower or

[1] On the Use to be made of the Chitinous Organs in the Cheilostomata in the Diagnosis of Species, &c., *Journ. Linn. Soc. Lond.* (Zool.), vol. xv. p. 357, 1881.

wider peduncular process, which usually, but not always, corresponds with a sinus or notch in the lower border of the orifice. The former kind may be termed "truncate" and the latter "pedunculate opercula."

2. *Structure.*—Some are composed of a continuous rigid, chitinous substance, but in the majority of cases the operculum is constituted of a thinner or stronger membrane, supported by a thickened chitinous border, to which are often added lateral rods or processes, or a more or less complicated framework; and they may be divided into;—

a. *Complete.*—In which the chitinous rim is continuous all round including the lower border.

b. *Incomplete.*—When the lower border remains membranous or is continuous, without distinct interruption, with the membranous endocyst of the zoœcium.

3. *Articulation of the Opercula.*—The mode in which the opercula are articulated varies very considerably. In those cases in which the zoœcia are completely calcified, as in the ESCHARINA generally, the operculum is directly articulated or attached to the sides of the orifice, usually at points near its inferior border, but sometimes higher up. The articulation is effected by an elastic fibrous ligament as it may be termed, which is generally inserted into a notch in the border of the operculum, but in some few cases into a projecting process, which corresponds to an incision in the border of the orifice on either side.

4. *Opercular Muscles.*—The motions of the operculum in the opening and closing of the orifice are effected by two pairs of muscles, occlusor and retractor, of which the former are the more important; these muscles are sometimes inserted with the intervention of a long slender tendon and sometimes immediately. The points and mode of attachment should be carefully noticed.

B. The other more important chitinous elements are the avicularian mandibles and vibracular setæ.

1. *Mandibles.*—These, like the opercula, exhibit very great variety of form, and not unfrequently several forms co-exist in one and the same species. But except in size, in which they often present greater differences than do the opercula, the characters of each particular type will be found remarkably constant.

Like the avicularia of which they form part, the mandibles may be divided into those adapted for a prehensile purpose, and those which form merely a movable lid to the cup or receptacle upon which they are seated.

In one division of the genus *Cellepora* (but only in those belonging to the southern hemisphere), in which the lower border of the orifice is straight and entire, the avicularian mandibles always present a slender process rising from the middle of the base, occasionally furnished with short hairs, to which I have applied the term *columella*.

a. The prehensile mandibles, though differing greatly in form, have certain characters in common which distinguish them from the other kind. In shape they vary from a simple semicircle or triangle to a more or less elongated, blunt, or acutely-pointed spear- or sword-shaped, formidable, weapon. They are formed of a strong chitinous frame with a base, by each extremity of which the mandible is articulated to the sides of its cup or receptacle, in which are lodged the occlusor and retractor muscles, &c. In this class of mandibles the sides towards the apex or upper border of the lower face are usually, but not always, finely toothed, and the apex, in the spear-shaped type especially, is very frequently furnished with an acute incurved point or fang. The interior of the chitinous frame is occupied by a membrane in which is almost always a large rounded or elongated *foramen*, above which are inserted the occlusor muscles, which usually constitute a distinct pair, but in one family (Adeoneæ) appear to be conjoined into a single band. By this arrangement it would seem that power rather than speed in the occlusion of the prehensile avicularium is provided for.

b. The retentive mandibles also present considerable variety of form, which may vary from a simple semicircle to all varieties of spatulate or duckbill-shape; usually rounded or obtuse but sometimes more or less bluntly pointed at the apex. They are generally simple, but occasionally bifid or trifid. Unlike the prehensile mandibles, they are constituted for the most part of a thin membranous expansion, supported only at the base or partially at the sides and lower part by a chitinous frame, by which also they are articulated. In this class of mandibles also the *foramen*, if present, is always close to the base, very near to which the weak occlusor muscles are inserted; we may conclude therefore that the retentive mandible is shut down with a sudden snap, or with great rapidity and but little force.

C. Besides the foregoing elements, which are almost universally present, others are met with which are limited to special groups; for instance, in the Family Salicornariadæ they consist of;—

1. A pair of slender curved rods imbedded in the ectocyst, one on each side of the orifice, and serving as *points d'appui* to the operculum; these I have termed *lateral trabeculæ*, but in some cases they are conjoined so as to form a complete or incomplete ring.

2. A very delicate chitinous, apparently tubular, filament contained in the areolar ridges, and constituting an "*areolar network*" continuous throughout each internode of the zoarium. (A somewhat similar network probably exists in some of the Selenariadæ.)

Very minute trabeculæ, somewhat similar to those of the Salicornariadæ, are found also in the genus *Steganoporella*, not on the sides but below the angles of the orifice.

The only other chitinous elements to which reference need be made are—

3. The so-termed *radical tubes* or *radicells*.

4. The different forms of clasping or connecting *tubular filaments*.

5. The *epitheca*, under which term is to be understood the more or less delicate cuticular investment, which, though in most cases very early removed by abrasion or otherwise, sometimes persists as a loosely attached epidermis, which may perhaps be regarded as homologically related to the chitinous wall of the radicell, and as representing the remains of the germinal membrane within which the entire zoarium is developed.

VII. Measurements.—The magnified figures are nearly all enlarged either 50 or 140 diameters, and in most cases a scale is appended to them. The measurements have been expressed in the decimal parts of an inch except in some few instances among the wood-cuts where the metric system has been used, but this is always marked on the figures.

The subjoined Table is given for the ready conversion of one system into the other.

Inches.	Millimetres.	Inches.	Millimetres.
·10	2·539	·60	15·239
·15	3·809	·65	16·509
·20	5·079	·70	17·779
·25	6·349	·75	19·049
·30	7·619	·80	20·319
·35	8·889	·85	21·589
·40	10·159	·90	22·859
·45	11·429	·95	24·129
·50	12·699	1·00	25·399
·55	13·969		

Table of Classification.

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ABBREVIATIONS.

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DESCRIPTION OF GENERA AND SPECIES.

Sub-Order I. CHEILOSTOMATA.

Division I.—STOLONATA.

Family I. Æteidæ.

Ætea, Lamouroux.

Family II. Eucrateadæ.

1. *Eucratea*, Lamouroux.
2. *Hippothoa*, Lamouroux.
3. *Pasythea*, Lamouroux.
4. *Brettia*, Dyster.

Family III. Chlidoniadæ.

Chlidonia, Savigny.

Family I. Æteidæ.

Æteidæ, Smitt, Hincks.
Scrupariadæ (pars), Brit. Mus. Cat.
Stolonata (pars), Carus.

Character.—Zoœcia tubular, with a subterminal membranous area; partly erect and free, partly decumbent and adherent; uniserial.

Ætea, Lamouroux.

Sertularia (pars), Linn., Delle Chiaje.
Cellularia (pars), Pallas.
Cellaria (pars), Solander.
Ætea, Lamx. [1812], Brit. Mus. Cat., Smitt, Hincks, &c.
Falcaria, Oken.
Anguinaria, Lamk. [1816], Fleming, Schweigger, Cuvier, Blainv., Busk, 1849; Gosse, Lister.

Character.—Zoœcia calcareous but more or less flexible; tubular, partly erect, partly horizontal; the horizontal portions forming a segmented, adnate fistular horizontal stolon. A large membranous area on one side towards the end of the erect portion. Orifice semicircular, subterminal.

Ætea anguina, Linné (sp.).

"*Snake Coralline*," Ellis.
Sertularia anguina, Linn.
Cellularia anguina, Pallas, Ellis.
Cellaria anguina, Solander.
Ætea anguina, Lamx., Brit. Mus. Cat., Smitt, Hincks, &c.
Falcaria anguina, Oken.
Sertularia mollis, Delle Chiaje.
Anguinaria anguina, Fleming, Lister,
„ *spatulata*, Lamk., Johnst., Busk, 1849, Gosse, &c.

Character.—Zoœcia curved towards the end and spatulate; surface finely annulate, except the spatulate part, in which the surface is finely spotted.

Habitat.—Station 36, off Bermuda, 30 fathoms, coral. Station 161, off Port Philip, 33 fathoms, sand. Stations 135A, &c., off Inaccessible Island, and Nightingale Island, Tristan da Cunha, 75 and 110 fathoms. Station 304, lat. 46° 53′ S., long. 75° 12′ W., 45 fathoms, green sand. Station 162, off East Moncœur Island, 38 to 85 fathoms, sand and shells.

Family II. Eucrateadæ.

Eucratiidæ (pars), Hincks.
Scrupariadæ (pars), Brit. Mus. Cat.

Character.—Zoœcium erect and free or decumbent, more or less adnate. Zoœcia uni- or biserial or geminate, pyriform, with a subterminal oblique orifice; unarmed.

The following genera are contained in the Collection:—

1. *Eucratea.*

(1) *Eucratea chelata* (Linné).

2. *Hippothoa.*

(1) *Hippothoa divaricata,* Lamouroux.

(2) *Hippothoa flagellum,* Manzoni (Pl. XXXIII. fig. 7).

3. *Pasythea.*

(1) *Pasythea eburnea* (Smitt) (Pl. XXXIV. fig. 1).

4. *Brettia.*

(1) *Brettia australis,* n. sp. (Pl. XXXIV. fig. 3).

(2) *Brettia cornigera,* n. sp. (Pl. XXXIV. fig. 6).

1. *Eucratea,* Lamouroux.

Scruparia, Brit. Mus. Cat., vol. i. p. 28, Oken [1813], &c.
Eucratea, Lamx. [1812], Johnst., Fleming, d'Orb. (pars), Smitt, Hincks, Auctt.
Unicellaria (sp.), Blainv.
Catenaria (pars), d'Orb.
Cellularia (pars), Pallas.
Cellaria (pars), Solander.
Sertularia (sp.), Linn.

Character.—Zoœcium usually with a creeping adherent base, erect, branching. Zoœcia calcareous, rising one from another singly. Aperture oblique, terminal or subterminal. Orifice semicircular, with a straight lower border. Branches springing from the front of a zoœcium below the aperture.

Eucratea chelata, Linné (sp.).

Sertularia chelata, Linn.
Cellularia chelata, Pallas, Bruguière, Bosc, Lamk.
Cellaria chelata, Ell. and Soland.
Eucratea chelata, Lamx., Johnst., Hincks, Smitt, Gosse, Alder, &c.
Scruparia chelata, Oken, Brit. Mus. Cat., Gray, Gosse, Wyv. Thoms., Hincks, Smitt, 1865.
Eucratea loricata, Fleming.
Unicellaria chelata, Blainv.
Catenaria chelata, d'Orb.
Crisia chelata, Johnst., Hassall.
Eucratée cornée, Milne-Edw.

Character.—Zoœcia in the form of a horn, short. Aperture oval, oblique; peristome thin, raised, membranous part of front depressed. Orifice semicircular. Branches arising from the front of a zoœcium close below the aperture (often aborted). Oœcia mitriform, acuminate, subcarinate.

Habitat.—Station 163A, off Twofold Bay, 150 fathoms, green mud.

[Cosmopolitan.]

2. *Hippothoa*, Lamouroux.

Catenicella (pars), Blainv.
Tubulipora, sp., Jameson.
Mollia (pars), Smitt.

Character.—Zoœcia calcareous, decumbent, adherent, usually distant and connected by tubular prolongations. Branches given off from the sides of a zoœcium. Orifice orbicular, sometimes produced and subtubular, with a sinus in the lower border.

(1) *Hippothoa divaricata*, Lamouroux.

Hippothoa divaricata, Lamx., Brit. Mus. Cat., Johnst., Auctt.
Mollia hyalina, forma *divaricata*, Smitt, Öfversigt k. Vetensk.-Akad. Förhandl., 1867.

Character.—Zoœcia ovate or pyriform. Surface usually striated transversely, and subcarinate in front. Orifice orbicular, with a median notch below.

Habitat.—Station 75, lat. 38° 38′ N., long. 28° 28′ W., 450 fathoms, volcanic mud. Station 135, Islands of Tristan da Cunha, 60 to 1000 fathoms, hard ground, shells and gravel.

[Cosmopolitan.]

(2) *Hippothoa flagellum*, Manzoni (Pl. XXXIII. fig. 7).

Hippothoa flagellum, Manz. Brioz. fossil., Ital. 4th Contrib, p. 6, pl. i. fig. 4; Suppl. alla Fauna d. Brioz. Medit.; 1st Contrib, p. 3, pl. i. fig. 5. (?); Hincks, Ann. and Mag. Nat. Hist. ser. 4, vol. xx. p. 218, 1877; Brit. Mar. Polyz., vol. i. p. 293, pl. xliv. figs. 5, 7.

Character.—Zoœcia ovate, smooth, not carinated, slightly elevated towards the upper end, not much produced below; connected by very slender, tubular processes; much longer than the zoœcium. Orifice subclithridiate; peristome slightly thickened. (Oœcia small, globose, smooth, borne on a partially developed cell, generally attached to the side of a normal zoœcium by a very short fibre, Hincks.)

Habitat.—Station 151, off Heard Island, 75 fathoms, volcanic mud (parasitic on *Myriozoum marionense*).

[Cosmopolitan; Pliocene.]

3. *Pasythea* (pars), Lamouroux.

Cellaria (pars), Solander.
Sertularia (pars), Gmelin.
Liriozoa, Lamk.
Tuliparia, Blainv.
Epicaulidium, Hincks.
Gemellipora (pars), Smitt.

Character.—Zoœcium, in the erect portion, consisting of a central stem formed either of calcareous clavate segments or of successive pairs of zoœcia. From the sides of the

stem opposite branches arise, consisting either of a single triplet, or of a succession of geminate zoœcia. Zoœcia connate, urceolate, contracted towards the orifice, which is suborbicular, with a minute articular notch on each side below.

In Dr. Solander's posthumous work, a species of *Cellaria* is described under the name of *Cellaria tulipifera*,[1] and also a species of *Sertularia* (*quadridentata*),[2] and excellent figures of both are given.

Lamouroux, fancying some resemblance between the figures of these two species, conjoined them into a distinct genus, *Pasythea*, which was included by him in his Order Sertularieæ.

He notices, however, the probability of their belonging to different genera.

About the same time Lamarck, perceiving, as Dr. Solander had done, the true affinities of the two forms, bestowed upon *Cellaria tulipifera* the name of *Liriozoa*, relegating the second species to its proper place among the Sertularians.

In 1834 Blainville,[3] with much less excuse, fell into the same error as Lamouroux, and reunited the two species into a Sertularian genus *Tuliparia*, in glaring defiance of all rules of nomenclature and without any apparent reason.

The only subsequent notice of *Pasythea* with which I am acquainted is that recently published by Mr. Hincks, who appears to have inadvertently overlooked the previous accounts of the species, and bestowed upon it the name of *Epicaulidium pulchrum*,[4] which, however, he afterwards corrected.[5]

Under these circumstances it may perhaps admit of question as to whether priority should be given to Lamouroux' or to Lamarck's appellation. But as in date it seems probable, though by no means certain, that the former was slightly in advance, it seems as well to adopt his name. The trifling point is not worth discussion.

Pasythea tulipifera is a very interesting form, but as it does not occur in the Challenger collection I need not notice it more particularly here. Nor in fact is there much to add to the excellent and succinct description of Dr. Solander, and that recently given by Mr. Hincks.

Pasythea eburnea, Smitt (sp.) (Pl. XXXIV. fig. 1).

Gemellipora eburnea, Smitt, Florid. Bryoz., pt. 2, p. 35, pl. vii. figs. 152–156, and pl. ix. figs. 177*a*, 178.

Character.—Zoœcium in the erect portion pinnate. Stem at first a double calcareous tube, then a succession of geminate zoœcia, of which two pairs constitute an internode,

[1] *Loc. cit.*, p. 27, pl. v. figs. a, A.
[2] *Ibid.*, p. 57, pl. v. figs. g, G.
[3] Man. d. Actinol., p. 485, pl. lxxxiii. fig. 1.
[4] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. vii. p. 156, pl. x. fig. 5, 1881.
[5] *Ibid.*, vol. viii. p. 135.

from the sides of which equidistant, opposite pinnæ, also composed of geminate zoœcia, are given off at right angles. Zoœcia geminate, closely connate, subcompressed, the oral portion subtubular and twisted round to opposite faces, front and back, in each pair. Surface smooth, entire, with a row of four to six puncta on each side, and a few on the front. Peristome slightly thickened.

Habitat.—Station 122, lat. 9° 5′–10′ S., long. 34° 49′–53′ W., 32 to 400 fathoms, red mud. Station 24, off Culebra Island, 390 fathoms, Pteropod ooze. Station 23, off Sombrero Island, 450 fathoms, Pteropod ooze. Off Barra Grande, Brazil, 400 fathoms.

[Gulf of Florida, 120 to 127 fathoms, Pourtalès.]

This very remarkable form affords a striking example of dimorphism. Though well described in most respects by Prof. Smitt, in both its forms, that excellent observer does not appear to have noticed the precise way in which the two are connected. "The species," he says, "in its erect state, from its ivory-white aspect and delicate stem, to the naked eye much resembles a *Crisia*. But closer examination shows the zoœcia to be arranged much as they are in *Gemellaria*, back to back in pairs, and apparently spirally arranged round an imaginary axis, owing to the circumstance that the zoœcia in the same longitudinal series have their mouths turned alternately to right and left." The stem and branches, as observed by Prof. Smitt, are articulated or divided into internodes, which in the stem consist of two or three pairs of zoœcia, from the lower pair of which alone the lateral branches arise, exactly opposite to each other; each branch springing from one of the two zoœcia.

Prof. Smitt does not appear to have met with specimens showing the mode in which the erect portion originates, and his description of the adnate zoœcia, and of the stoloniform tubes on which they are formed, does not convey exactly the true nature of the latter. In the specimen of *Pasythea eburnea* procured off Sombrero Island, the mode of origin and the nature of the connection between the adnate and erect portions are beautifully displayed.

On a small fragment of Coral or *Myriozoum*, four or five very young growths are seated, each of which arises from the centre of a circular, somewhat tumid disc, which is hollow, with thin, transparent, slightly calcified walls. The first internode of the erect stem consists of a double connate tube. The subsequent internodes are developed, each into two or three pairs of zoœcia, the lowermost one or two being more or less abnormally formed. From the outer border of this radical disc proceed four or five very slender and delicate, adnate stoloniform jointed tubes, upon which at rare intervals a decumbent Hippothoiform zoœcium, of the same size and form, as those in the erect part of the growth, is developed; whilst the tube itself connects one central disc with another. The occurrence of zoœcia in the course of the stoloniform tubes gives the growth very much the aspect, as Prof. Smitt remarks, of a dwarf *Hippothoa divaricata*.

When the calcareous matter is removed by weak acid, the chitinous basis of the zoœcia is seen to be very delicate and transparent; and in this condition the puncta visible in the wall of the zoœcium in its natural state appear as oval rings, occupied by a delicate membrane (fig. 1, *e*), in the centre of which is a nuclear mass, consisting of five or six highly refractive globular particles. The puncta, therefore, as in many other cases, are not truly pores, but appear to be of the same nature as the common interzoœcial discs or so-called "Rosettenplatten."

4. *Brettia*, Dyster.

Brettia, Dyster, Quart. Journ. Micr. Soc., vi., 1858, p. 260; Hincks, Brit. Mar. Polyz., p. 27.

Character.—Zoœcium erect, corneous or subcorneous. Zoœcia given off from the upper and back part of the subjacent one, above and behind the aperture; all facing the same way; uniserial, elongate, tubular or trumpet-shaped, with a large terminal or subterminal aperture, and a small semicircular orifice. (Margin of aperture with or without spines.)

(1) *Brettia australis*, n. sp. (Pl. XXXIV. fig. 3).

Character.—Zoœcium very small, regularly dichotomising, each zoœcium giving off a pair. Zoœcia trumpet-shaped, slightly curved. Aperture oblique or subterminal, rounded or oval. Margin unarmed.

Habitat.—Station 196, lat. 0° 48′ S., long. 126° 58′ E., 825 fathoms, hard ground. (Parasitic on *Bicellaria bella.*)

Only a single minute specimen of this very elegant species has been noticed in the collection. It is excessively delicate and transparent, but at the same time presents a pearly aspect, showing that it is not wholly "corneous."

(2) *Brettia cornigera*, n. sp. (Pl. XXXIV. fig. 6).

Character.—Zoœcium lax, composed of dichotomous branches, springing from a common stem formed of radical tubes. Lower internodes very long and tubular, with a rudimentary aperture and uninhabited. Upper ones trumpet-shaped, much elongated and tubular downwards, with an oval aperture nearly half the length of the cell; four small pointed submarginal spines above, in front, and two behind. Oœcia, 0 (?) Avicularia, 0.

Habitat.—Station 23, off Sombrero Island, 450 fathoms, Pteropod ooze.

Family III. Chlidoniadæ.

Character.—Zoœcium composed of upright, free, segmented stems, springing from a stolonate network. From the segments, after the first bifurcation, arise lateral branches consisting of chains of zoœcia arising from the back near the summit. Zoœcia bicamerate; unarmed.

Chlidonia, Savigny.

Chlidonia, Savigny [1811], d'Orb., 1850.
Eucratea, Audouin.
? *Vorticella*, Linn., Esper.
Cothurnicella, Wyv. Thoms.

Character.—Free portion of the zoœcium composed of segmented tubular stems, with distant short branches, each springing from one of the internodes of the stem, and giving off numerous uniserial chains of zoœcia, one rising from the back of another near the top, and all looking one way. Zoœcia gibbous, pyriform, or attenuated downwards. Orifice prominent or subtubular, semicircular, lower lip entire, straight. The cavity of the zoœcium divided into two chambers, the hinder of which is much curved, and alone communicates with the orifice and lodges the polypide.

This very remarkable form, originally named *Chlidonia*[1] by M. Savigny, was afterwards renamed *Eucratea* by Audouin. It is, however, quite distinct from that genus, and M. d'Orbigny was fully justified in returning to the original appellation. As remarked by M. d'Orbigny (Palæont. Franç., p. 40), *Chlidonia* is clearly distinguished from *Catenicella* and *Catenaria* by its general habit; and its peculiarities appear to me to be such as fairly to entitle it to become the type even of a distinct family.

Each of the lateral branches supporting the tufts of zoœcial chains, springs from a distinct short forked internode of the non-celliferous main stem, whose internodes, as remarked by M. d'Orbigny, represent aborted zoœcia. The stem may, in fact, be regarded as a much developed radical tube, and in like manner each secondary branch and the chains of zoœcia are manifestly nothing more than successive internodes, which in the latter are dilated into habitations for the Polypides. Another remarkable peculiarity, though not one altogether confined to this genus, is seen in the partition of the interior of the zoœcium into two distinct chambers, apparently having no communication between them.

Chlidonia cordieri, Audouin (sp.) (Pl. XXVIII. fig. 11).

Eucratea cordieri, Audouin, Expl. i. p. 243, Savigny, Egypte, pl. xiii. fig. 3.
Chlidonia cordieri, d'Orb., Palæont. Franç., p. 40.
Cothurnicella dædala, Wyv. Thoms., Nat. Hist. Rev., vol. v. p. 146.

Character.—Zoœcia small, much attenuated or tubular downwards.

Habitat.—Station 186, Cape York, 8 to 11 fathoms, coral mud.

[1] Only at the bottom of the Plate.

At first sight I had regarded this form as specifically distinct from the well-known Atlantic and Mediterranean species; but upon further examination it is obviously to be regarded merely as a variety. The typical form has been described by Sir Wyville Thomson (Nat. Hist. Review, vol. v., 1858), from Port Philip, under the name of *Cothurnicella dædala*. The comparison of a specimen with which I was favoured by Sir Wyville Thomson, with one from "Egypt," shows that the two are identically the same. The species, therefore, would seem to be very generally distributed, occurring, according to d'Orbigny, in the Mediterranean and at the Canaries, and I have specimens from the coast of Calvados, from Nice, Egypt (Sir Jos. Banks), and Tyre (Mrs. Gatty).

Division II.—RADICELLATA.

Group A. CELLULARINA.

Family IV. Catenariadæ.

Catenaridæ (pars), d'Orb., 1850–52.
Catenicellidæ, *Scrupariadæ* (pars), Busk, 1852.
Cellularieæ (pars), Smitt.

Character.—Zoœcium radicate, segmented, internodes, except at a bifurcation, formed of a single zoœcium.[1]

The Challenger Collection contains the following genera:—

1. *Catenicella*, Blainville.

§ α. *fenestratæ.*

(1) *Catenicella ventricosa*, Busk.
(2) *Catenicella hastata*, Busk.
(3) *Catenicella plagiostoma*, Busk.
(4) *Catenicella cribraria*, Busk (Pl. I. fig. 6).

§ β. *vittatæ.*

(5) *Catenicella sacculata*, n. sp. (Pl. I. fig. 7).
(6) *Catenicella elegans*, Busk (Pl. I. figs. 2, 3, 5).
(7) *Catenicella umbonata*, Busk (Pl. I. fig. 1).
(8) *Catenicella pulchella*, Maplestone (Pl. I. fig. 4).

[1] In *Calpidium*, the internode may be said to be bi- or tri-locular, as it presents in front two or three oval orifices, although behind it exhibits no trace of division.

2. *Catenaria*, Savigny.

(1) *Catenaria attenuata*, n. sp. (Pl. II. fig. 1).
(2) *Catenaria bicornis*, n. sp. (Pl. II. fig. 2).
(3) *Catenaria diaphana*, Busk (Pl. II. fig. 3).

1. *Catenicella*, Blainville.

Catenicella (pars), Blainv., d'Orb., Brit. Mus. Cat., &c.
Catenaria (pars), Savigny.
Eucratea (sp.), Audouin.
Cellaria (pars), Lamk.

Character.—Internodes usually unicellular; the zoœcia arising one from the upper and back part of another, by a corneous tube, all facing the same way and forming dichotomously divided branches of an erect phytoid zoœcium. The zoœcium at each bifurcation geminate; each zoœcium with two lateral, usually trilocular, processes (*alæ*). Oœcia either subglobose and terminal or immersed, and placed below the orifice of a zoœcium in front.

§ *a. fenestratæ.*

Front fenestrate. Oœcia terminal.

(1) *Catenicella ventricosa*, Busk, var. *maculata.*

Catenicella ventricosa, var. *maculata*, Bk., Brit. Mus. Cat., vol. i. p. 7, pl. iii. figs. 4, 5.
Cellaria catenulata, Lamk.

Character.—Zoœcia ovate, compressed. Alæ wide, having sometimes a cup-like cavity above, which is occasionally closed, and formed into a broad conical spine. Fenestræ seven, with fissures radiating towards a rounded central pore. Surface of front studded with minute acuminate papillæ; back smooth, sometimes with dark spots.

Habitat.—Station 163A, off Twofold Bay, lat. 36° 57′ S., long. 150° 34′ E., 150 fathoms, green mud.

[Bass Strait, 45 fathoms, Voy. of Rattles.; Victoria, Macgillivray.]

(2) *Catenicella hastata*, Busk.

Catenicella hastata, Bk., Brit. Mus. Cat., vol. i. p. 7, pl. ii. figs. 3, 4; Voy. of Rattles., vol. i. p. 355; Macgilliv., Nat. Hist. Vict. Dec. iii., p. 19, pl. xxiv. fig. 4.
Catenicella bicuspis, Gray, Dieffenb., N. Z., vol. ii. p. 293.

Character.—Zoœcia ovate. Fenestræ numerous, disposed round a scutiform area, with fissures radiating towards the middle line. Lateral processes very wide, upper

loculus large, pyramidal, compressed, with five or six perforations before and behind. Dorsal surface finely sulcate.

Habitat.—Station 162, off East Moncœur Island, 38 fathoms, sand and shells. Station 161, off Port Philip, 33 fathoms, sand. Station 163A, off Twofold Bay, 150 fathoms, green mud.

[Bass Strait, 45 fathoms, Voy. of Rattles.; New Zealand, Dieffenb.; Queenscliff, &c., Victoria, Macgillivray.]

(3) *Catenicella plagiostoma*, Busk.

Catenicella plagiostoma, Brit. Mus. Cat., vol. i. p. 8, pl. v. figs. 1, 2; Voy. of Rattles., vol. i. p. 358, Macgilliv., *loc. cit.*, p. 17, pl. xxiv. fig. 2.
Cellaria catenulata (pars), Lamk.

Character.—Zoœcia large, wide, ovoid. Front divided into five large subtriangular fenestræ by four broad bands. Orifice arcuate, with a straight entire lower lip, and placed obliquely. Lateral processes very large (sometimes only on one side), rising into an acute spinous point and deeply cupped above. Avicularian loculus variable in size, sometimes more than half the length of the cell. Dorsum with a broad central band and two narrower bands branching from it on each side. Surface between the bands beset with setose spines.

Habitat.—Station 163A, off Twofold Bay, 150 fathoms, green mud. Station 163B, Port Jackson, 35 fathoms, hard ground.

[Bass Strait, 45 fathoms; Swan Island, Banks Strait, Voy. of Rattles.; Victoria, "very common" Macgillivray.]

(4) *Catenicella cribraria*, Busk (Pl. I. fig. 6).

Catenicella cribraria, Brit. Mus. Cat., vol. i. p. 9, pl. v. figs. 3, 4; Voy. of Rattles., vol. i. p. 359, Macgilliv., *loc. cit.*, p. 20, pl. xxiv. fig. 6.

Character.—Zoœcia subglobose, compressed. Fenestræ numerous, punctiform, equidistant, the circumferential larger than the rest. A minute central crescentic pore. Orifice semicircular, lower lip straight, entire (when perfect); lateral processes with the upper loculus suppressed, and the lowest prolonged downwards, forming an elevated wing on each side. Dorsal surface smooth.

Habitat.—Station 161, off Port Philip, 33 fathoms, sand.

[Bass Strait, Hooker; Cook's Strait, New Zealand, Lyall; Queenscliff, &c., Victoria Macgillivray.]

I have added a figure of this form, as that in the Brit. Mus. Cat. scarcely gives a fair representation of it.

§ *β. vittatæ.*

(5) *Catenicella sacculata*, n. sp. (Pl. I. fig. 7).

Character.—Zoœcia elongated and attenuated downwards. Surface highly polished. A small delicate-walled pouch in front of the lower lip with four or five minute punctures. Orifice arcuate, with an entire lower lip. Lateral processes very small, reduced almost entirely to a small avicularium. Vittæ wide and long-pointed at each end, and with a single row of dots down the middle.

Habitat.—Station 122, lat. 9° 5′ S., long. 34° 49′–53′ W., 32 to 400 fathoms, red mud.

At first sight this might be taken for a very robust form of *Catenicella elegans*, but they differ very materially. The chief differences are:—1, The presence of a small perforated pouch immediately in front of the orifice, and formed as it would seem by the protrusion of the lower lip; 2, the great width and peculiar form of the vittæ; 3, the perfectly smooth surface; and 4, the comparatively stunted condition of the lateral processes, in which the superior and inferior loculi are aborted, and the correspondingly minute size of the avicularia.

(6) *Catenicella elegans*, Busk (Pl. I. figs. 2, 3, 5).

? *Eucratea contei*, Aud., Exp. i. 242; Savigny, Egypte, pl. xiii. fig. 1.
Catenicella savignyi, Blainv., Man. d. Actinol., p. 462, pl. lxxviii. fig. 5.
„ *elegans*, Bk., Voy. of Rattles., vol. i. p. 361, pl. i. fig. 2; Brit. Mus. Cat., vol. i. p. 10, pl. ix.; Macgilliv., Nat. Hist. Vict. Dec., iii. p. 23, pl. xxiv. fig. 10.

Character.—Zoœcia slender, ovoid, surface finely papillose. Oœcial cell geminate. Lateral processes reduced to the avicularian loculus, which is usually large and projecting, with a perforation at the base. Vittæ long, narrow, with a single series of dots.

Habitat.—Station 122, lat. 9° 5′ S., long. 34° 49′ W., 32 to 400 fathoms, red mud. Station 188, lat. 9° 59′ S., long. 139° 42′ E., 28 fathoms, green mud. Station 135, Tristan da Cunha, 60 to 1100 fathoms, hard ground, shells, gravel. Station 163A, off Twofold Bay, 150 fathoms, green mud.

[Bass Strait, 47 fathoms; Port Cooper, Banks' Peninsula; Algoa Bay; Port Dalrymple; Madeira, J. G. J.; Mediterranean or Red Sea, Savigny; Victoria, Macgillivray.]

Mr. Macgillivray remarks that in most of the specimens with ovicells the lateral processes are very small. In any case, however, they vary a good deal in size. In some cases (fig. 5) the surface seems to be quite smooth, presenting none of the minute papillæ.

(7) *Catenicella umbonata*, Busk, var. (Pl. I. fig. 1).

Catenicella umbonata, Bk., Brit. Mus. Cat., vol. i. p. 11, pl. x. figs. 4, 5; Voy. of Rattles., vol. i. p. 362.

Character.—Zoœcia pyriform, contracted below, bulging or ventricose above. Lateral processes reduced to the avicularian loculus, which is large and strong, usually with a perforated border above (probably representing the superior loculus). Vittæ long and narrow, extending from the level of the mouth to the bottom of the zoœcium, usually furnished with acuminate papillæ. A broad compressed projecting process on the middle of the back.

Habitat.—Station 163B, off Port Jackson, 35 fathoms, hard ground.

[Bass Strait, 45 fathoms, Voy. of Rattles.; Tasmania, Mrs. Smith.]

The variety in the Challenger collection differs from the typical form in its great delicacy of structure, and the only occasional presence of the dorsal prominence. Nor does it show any papillary processes or vittæ, on the front.

(8) *Catenicella pulchella*, Maplestone (Pl. I. fig. 4).

Catenicella pulchella, Maplest., Journ. Micr. Soc. Victoria, vol. i. (1880), p. 64, pl. v. fig. 4.

Character.—Zoœcia flattened in front, convex behind, ovate in outline, surface quite smooth. Orifice semicircular, lower lip emarginate. A row of large circular raised spots on each side. Lateral processes short and thick, subconical, with a perforation at the base (seen on the side).

Habitat.—Station 163B, off Port Jackson, 35 fathoms, hard ground.

[Australia, Maplestone.]

"An interesting form" as Mr. Maplestone remarks, and at first sight scarcely referrible to either the fenestrate or vittate section. But it appears properly to belong to the latter. The lateral series of elevated discoid spots may be regarded as homologous with the vittæ, and as in the other *Vittatæ*, the oœcia are not terminal, but as Mr. Maplestone says "geminate and not terminal."

The lateral spots are completely covered with a sort of convex lid, and have the aspect of pustulose elevations.

Catenicella pulchella differs from *Catenicella rufa* in its white colour and the absence of puncta all over the front, as well as in the absence of the peculiar dorsal stigmata which exist in the latter species.

2. *Catenaria*, Savigny.

Catenaria (pars), Savigny, 1811 (on Plates); (pars), d'Orb., Palæont. Franç., p. 42, 1850–1852.
Eucratea (pars), Audouin (*nec* Lamx., Blainv.).
Alysidium (pars), Bk., Brit. Mus. Cat., 1852.

Character.—Zoarium erect or free, dichotomously branched; the zoœcium at each bifurcation single. Zoœcia elongate, subtubular or trumpet-shaped, without a frontal aperture. Mouth orbicular or semi-orbicular. Avicularia present or absent.

The typical species I have assumed for this genus is the *Eucratea lafontii* of Audouin (Savigny, Egypte, pl. xiii. fig. 2).

(1) *Catenaria attenuata*, n. sp. (Pl. II. fig. 1).

Character.—Zoarium extremely delicate, laxly spreading. Zoœcia very long, slender, tubular below, trumpet-shaped above. Orifice large arcuate; lower lip entire, straight. Avicularia, 0. Oœcia (?).

Habitat.—Station 151, off Heard Island, 75 fathoms, volcanic mud.

(2) *Catenaria bicornis*, n. sp. (Pl. II. fig. 2).

Character.—Zoarium plumose, very delicate. Zoœcia tubular below, ventricose and ovate or subglobular above. Surface highly polished. Front occupied almost entirely by an oval bordered area (not membranous), in which is a median pore immediately below the mouth, and several others arranged in a crescentic series on each side; all the pores surrounded by a thickened border. Orifice semicircular; lower lip straight, entire. A retrocedent sessile avicularium behind each upper angle. Oœcium galeriform, ofty, terminal.

Habitat.—Station 280, lat. 18° 40′ S., long. 149° 52′ W., 1940 fathoms, Globigerina ooze.

(3) *Catenaria diaphana*, Busk (Pl. II. fig. 3).

Scruparia diaphana, Bk., Quart. Journ. Micr. Sci., vol. viii. p. 281, pl. xxxi. figs. 1, 1*a*.

Character.—Zoarium irregularly ramose. Zoœcia pyriform, elongated; anterior wall sparsely punctured, with a slender continuous vitta (?) on each side. Orifice orbicular, slightly sinuated below. Peristome thin, subtubular, entire.

Habitat.—St. Paul's Rocks, North Atlantic, shallow water.

[Madeira, J. Y. J.]

In the description of *Scruparia diaphana* (*loc. cit.*), the peristome is stated to be notched above, but this defective condition appears to be only occasional.

The separation of this peculiar form from *Catenicella* is entirely artificial, and it has been placed under *Catenaria* simply for its mode of branching, and the absence of any lateral appendages.

Family V. Cellulariadæ, Busk.

Cellulariidæ, Bk., Crag Polyzoa, p. 19; Hincks.
Cellulariadæ, Brit. Mus. Cat.
Cellularidæ (pars), Johnst.
Cellularieæ (pars), Smitt.

Character.—Zoarium articulated, phytoid, erect, dichotomous, bi,- tri,- or multiserial. Zoœcia rising by a broad base, alternate, all facing the same way; a large oval membranous aperture. Avicularia, when present, sessile, and either lateral or anterior.

The Family contains the following genera :—

1. *Cellularia*, Pallas (pars).

§ α. *apertæ.*

(1) *Cellularia crateriformis*, n. sp. (Pl. III. fig. 1).
(2) *Cellularia cuspidata*, Busk.
(3) *Cellularia cirrata*, n. sp. (Pl. II. fig. 4).
(4) *Cellularia quadrata*, n. sp. (Pl. V. fig. 5).

§ β. *fornicatæ.*[1]

(5) *Cellularia biloba*, n. sp. (Pl. III. fig. 2).
(6) *Cellularia elongata*, n. sp. (Pl. III. fig. 3).

2. *Menipea*, Lamouroux.

§ α. *fornicatæ.*

(1) *Menipea benemunita*, n. sp. (Pl. IV. fig. 4).
(2) *Menipea aculeata* (d'Orbigny) (Pl. IV. fig. 2).
(3) *Menipea clausa*, n. sp. (Pl. IV. fig. 5).

§ β. *apertæ.*

(4) *Menipea flabellum*, Lamouroux.
(5) *Menipea flagellifera*, n. sp (Pl. IV. fig. 1).
(6) *Menipea marionensis*, n. sp. (Pl. IV. fig. 3, and Pl. XIV. fig. 9).
(7) *Menipea triseriata*, Busk.
(8) *Menipea cirrata*, Lamouroux.
(9) *Menipea pateriformis*, n. sp. (Pl. V. fig. 4).

[1] A better term perhaps would have been "scutatæ," but as Prof. Smitt has introduced the term "fornix" for what I had originally named "operculum," now generally employed for the oral valve, I have adopted his name.

3. *Emma*, Gray.

Emma crystallina, Gray.

4. *Scrupocellaria*, van Beneden.

(1) *Scrupocellaria macandrei*, Busk (Pl. XI. fig. 4).
(2) *Scrupocellaria ciliata* (Audouin) (Pl. XI. fig. 5).
(3) *Scrupocellaria ornithorhynchus* (Wyv. Thoms.) (Pl. XI. fig. 6).
(4) *Scrupocellaria pilosa* (Audouin) (Pl. XI. fig. 7).
(5) *Scrupocellaria securifera*, n. sp. (Pl. XI. fig. 2).

5. *Canda*, Lamouroux.

(1) *Canda arachnoides*, Lamouroux.
(2) *Canda simplex*, n. sp. ? (Pl. XIV. fig. 8).

6, *Nellia*, Busk.

(1) *Nellia oculata*, Busk.
(2) *Nellia simplex*, Busk (Pl. V. fig. 6).

7. *Caberea*, Lamouroux.

§ *α. fornicatæ.*

(1) *Caberea rostrata*, n. sp. (Pl. XXXII. fig. 4).
(2) *Caberea crassimarginata*, n. sp. (Pl. XI. fig. 1).
(3) *Caberea darwinii*, Busk (Pl. XXXII. fig. 6).
(4) *Caberea rudis*, Busk.
(5) *Caberea minima*, n. sp. (Pl. XXXII. fig. 5).

§ *β. apertæ.*

(6) *Caberea lata*, Busk (Pl. XI. fig. 3).

1. *Cellularia*, Pallas (pars).

Bugula (pars), Gray.

Character.—Zoarium bi- or tri-serial, with more than four cells in each internode; with or without a sessile avicularium behind the upper and outer angle; with or without a pedunculate fornix.

§ *α. apertæ.*

(1) *Cellularia crateriformis*, n. sp. (Pl. III. fig. 1).

Character.—Zoarium 2 to 3 inches high, lax, flaccid, straggling, branches long, very irregular. Zoœcia elongated, narrow (0″·04 × ·005). Aperture oval, border wide,

and raised into an expanded cup. Two (sometimes only one) very strong and long, jointed spines on the outer side, and a slender unjointed one on the inner side, above. Avicularium (sometimes absent) rather large, mandible triangular, pointed, not curved. Oœcium lofty, surface smooth, lower border simple entire.

Habitat.—Station 325, lat. 36° 44′ S., long. 46° 16′ W., 2650 fathoms, blue mud. Station 323, lat. 35° 39′ S., long. 50° 47′ W., 1900 fathoms, blue mud.

Peculiar in the very lax growth and straggling branches, all composed principally of interlaced radical tubes, supporting single or sets of zoœcia at irregular distances apart. The cup-like expansion also around the aperture is very characteristic, and the two occasionally very large jointed spines on the outer side much resemble the antennæ of an insect. One of these apparently arises, not from the margin of the aperture, but behind it. Occasionally a radical tube may be seen supporting, instead of an ordinary zoœcium, a small curiously formed avicularium.

(2) *Cellularia cuspidata*, Busk.

Cellularia cuspidata, Bk., Brit. Mus. Cat., vol. i. p. 19, pl. xxvii. figs. 1, 2.
„ *monotrypa*, Bk., Voy. of Rattles., vol. i. p. 368.

Habitat.—Station 161, off entrance to Port Philip, 33 fathoms, sand.
[Australia; New Zealand, Darwin, Hooker, Lyall, &c.]

Mr. Hincks (Brit. Mar. Polyz., p. 36) remarks that the presence of the cuspidate point on the median cell at each bifurcation is not a distinctive mark of the Australian *Cellularia cuspidata*, but belongs to *Cellularia peachii* as well. If this be the case, it might perhaps be proper to recur to my original name of *Cellularia monotrypa* to distinguish the former. But the presence of a cusp cannot by any means be constant, at any rate in the British form, as it is totally wanting in the only specimen I have seen, and from which my original description of *Cellularia peachii* (Ann. and Mag. Nat. Hist., ser. 2, vol. vii. p. 82, pl. viii. figs. 1, 2, 3, 4) was drawn up.

(3) *Cellularia cirrata*, n. sp. (Pl. II. fig. 4).

Character.—Zoarium about 3 inches high. Branches much curled and interlaced, forming a dense tuft. Zoœcia entirely open and sessile, with a broad base. Orifice broad-oval, contracted at the summit, margin rather thick, smooth. A blunt, curved, acuminate point at the summit of each zoœcium, and a large avicularium behind the upper and outer angle. Oœcium formed of an entire metamorphosed zoœcium, with a wide opening closed by a broad valve having a semilunar chitinous border.

Habitat.—Station 195, lat. 4° 21′ S., long. 129° 7′ E., 1425 fathoms, blue mud.

The general structure of this species is very peculiar, and together with other characters might perhaps justify its erection into a distinct genus. The cells, different from those of nearly all the other Cellulariadæ, are entirely open in front, and of equal width throughout below the immediate summit, which is contracted to the width of the crescentic mouth. They are seen to arise, when viewed from behind, by a very broad base, from the side as it were, of the subjacent cell. The consequence of this is that they are all placed obliquely with respect to the axis of the branch, standing out on either side with extreme regularity. The only specimen in the collection is about three inches high, and the curling branches form a thick entangled tuft, very difficult to unravel. The main stem is of considerable thickness, and composed of a closely packed bundle of radical tubes, which at the lower extremity break up into innumerable and very fine jointed filaments, each of which becomes attached to a *Globigerina*-shell, or other small solid particle, the whole forming a thick floccose tuft, composed of the fibres and attached particles.

(4) *Cellularia quadrata*, n. sp. (Pl. V. fig. 5).

Character.—Ten to fourteen zoœcia in each internode, biserial, the two series facing different ways at a slight angle. Zoœcia quadrate, entirely open in front, the aperture slightly contracted by a very narrow lamina. Surface of border and lamina very delicately frosted. Dorsal surface smooth entire. A small lateral avicularium slightly in front of the superior angle.

Habitat.—Station 149D, Royal Sound, Kerguelen, 28 fathoms, volcanic mud. Station 151, Heard Island, 75 fathoms, volcanic mud.

Closely allied, apparently, to *Menipea ornata*, but differs from it in the much less developed lamina, and the absence of any anterior avicularia, and the more elongated form of the cells, which in the former species are nearly square.

§ *β. fornicatæ.*

(5) *Cellularia biloba*, n. sp. (Pl. III. fig. 2).

Character.—Zoarium lax, straggling, branches very slender. Zoœcia trumpet-shaped. Orifice oval, with a much raised crateriform border. Four or five slender, oral spines, and a bilobed pedunculate fornix. A small avicularium situated quite behind the angle of every zoœcium, with an acute mandible pointing downwards.

Habitat.—Station 76, lat. 38° 11′ N., long. 27° 9′ W., 900 fathoms, Pteropod ooze.

The avicularium is entirely posterior, and is not visible in a front view; and it is quite immersed.

(6) *Cellularia elongata* n. sp. ? (Pl. III. fig. 3).

Character.—Zoarium loosely branched, branches straight. Zoœcia much elongated, tubular, orifice oval, with a smooth thin border; three to five long slender acicular oral spines; an oval, entire, pedunculate fornix, nearly as large as the aperture. A small avicularium visible in front on most of the zoœcia.

Habitat.—Station 149D, Royal Sound, Kerguelen, 28 fathoms, volcanic mud.

A very delicate and beautiful species.

2. *Menipea*, Lamouroux.

Cellaria (pars), Linn. and Auctt.
Menipea, Lamx., d'Orb., Brit. Mus. Cat., Hincks, Wyv. Thoms., &c.
Crisia (pars), Lamx.
Tricellaria (sp.), Fleming, Blainv., Gray.
Cellularia (pars), Johnst., Smitt.
Cellarina (pars), v. Bened.

Character.—Zoœcia oblong, usually attenuated below, rising from a broad base; from three to fifteen in each internode. A sessile lateral avicularium (frequently aborted), and usually one or more sessile avicularia on the front below the aperture, or on a special tract between the series of zoœcia. Vibracularia, 0. With or without a pedunculate fornix.

§ *a. fornicatæ.*

(1) *Menipea benemunita*, n. sp. (Pl. IV. fig. 4).

Character.—Zoarium composed of short forked divaricate rather thick branches. Zoœcia tri- or quadri-serial. Orifice entirely covered by a large spatulate or spout-like fornix. Usually three spines on the outer side, of which the lowest is much smaller than the others, and one on the inner side; two sessile avicularia on the front of the median zoœcia, and one on the outer one placed below the orifice. Dorsal surface longitudinally wrinkled.

Habitat.—Station 313, lat. 52° 20′ S., long. 67° 39′ W., 55 fathoms, sand. Station 303, lat. 45° 31′ S., long. 78° 9′ W., 1325 fathoms, blue mud. Station 149H, I, K, Christmas Harbour, Kerguelen, 45 to 127 fathoms. Station 314, lat. 51° 35′ S., long. 65° 39′ W., 70 fathoms, sand. Station 315, lat. 51° 40′ S., long. 57° 50′ W., 5 to 12 fathoms, sand and gravel.

In this species the branches are all bordered by very closely adnate calcified radical tubes.

(2) *Menipea aculeata*, d'Orbigny (sp.) (Pl. IV. fig. 2).

Tricellaria and *Ternicellaria aculeata*, d'Orb., Voy. en Amér. Mérid., p. 8, pl. ii. figs. 1–4.
(?) *Menipea fuegensis* Bk., Kerg. Polyz., Phil. Trans., p. 194; Brit. Mus. Cat., vol. i. p. 21, pl. xix.

Character.—Zoœcia, three in each internode, much elongated and attenuated inferiorly. Aperture about one-third the length of the cell; bordered, slightly thickened. Three spines above; a small, bi- tri-furcate fornix. A small avicularium in front, below the aperture.

Habitat.—Station 303, lat. 45° 31′ S., long. 78° 9′ W., 1325 fathoms, blue mud. Station 314, lat. 51° 35′ S., long. 65° 39′ W., 70 fathoms, sand. Station 315, lat. 51° 40′ S., long. 57° 50′ W., 5 to 12 fathoms, sand and gravel.

[Kerguelen Island, Eaton; Patagonia, d'Orbigny.]

Menipea fuegensis, Brit. Mus. Cat., vol. i. p. 21, pl. xix., is of much stronger growth, and has four spines and a simple ligulate fornix; and the cells are less attenuated.

(3) *Menipea clausa*, n. sp. (Pl. IV. fig. 5).

Character.—Zoarium opaque ivory white, about 1 inch high, composed of few straggling, dichotomous branches, rising from a slender stem, composed of a close bundle of partially calcified radical tubes, the fibrous extremities of which are attached to dead Globigerina shells. Zoœcia much elongated, sub-cylindrical inferiorly, the upper third forming an oval dilatation; aperture wide, completely covered by a convex fornix, which is connate with the border of the aperture, and fissured all round except at the part where the pedicle of the fornix arises on the inner side. The mouth of the cell (the lower border of which is formed by the upper edge of the fornix) is semicircular. Two oral spines on the outer and one on the inner side of the mouth. A small avicularium in front below the aperture, and a very minute one behind the cell near the summit. Oœcia lofty, narrow; surface polished.

Habitat.—Station 70, lat. 38° 25′ N., long. 35° 50′ W., 1675 fathoms, Globigerina ooze.

This extremely beautiful form is remarkable for the peculiar development of the pedunculate fornix, which forms a complete calcareous cover to the aperture; but that this cover is in reality nothing more than a magnified fornix, is obvious from the circumstance that, like that appendage in many other cases, it is formed of concentric rings starting from the site of the peduncle.

The back of the branches is covered by numerous calcified radical tubes, each individual zoœcium apparently being supplied with one.

§ *β. apertæ.*

(4) *Menipea flabellum*, Lamouroux.

Cellularia ornata, Bk., Brit. Mus. Cat., p. 20, pl. xxvi. figs 3, 4.
? *Menipea flabellum*, Lamx.
Cellaria flabellum, Ell. and Soland.

Habitat.—Simon's Bay, Cape of Good Hope.
[Algoa Bay, Natal.]

(5) *Menipea flagellifera*, n. sp. (Pl. IV. fig. 1).

Character.—Zoœcia six to nine in each internode, obovate (viewed behind). Aperture about half the length, regularly oval. Peristome thin, quite smooth. A single oral spine above on the outer side. A small angular avicularium to every cell, and a pouch-like vibracularium on the front below the aperture.

Habitat.—Station 149D, Royal Sound, Kerguelen, 20 to 60 fathoms. Station 149H, I, K, off Christmas Harbour, 45 to 127 fathoms. Station 313, lat. 52° 20′ S., long. 67° 39′ W., 55 fathoms, sand. Station 314, lat. 51° 35′ S., long. 65° 39′ W., 70 fathoms, sand. Off Marion Island, 50 to 75 fathoms.

(6) *Menipea marionensis*, n. sp. (Pl. IV. fig. 3, and Pl. XIV. fig. 9).

Character.—Nine to fifteen zoœcia in each internode, each series facing outwards so as to form an obtuse angle down the front of the branch; very little contracted below. Aperture oval, occupying rather more than half the length of the zoœcium. Margin thin, smooth, two slender spines on each side above. A lateral avicularium to each cell and a small one in front, below the aperture, and close to the median line of the branch. Oœcia shallow, cucullate, wall entire.

Habitat.—Station 142, lat. 35° 4′ S., long. 18° 37′ E., 150 fathoms, green sand. Off Marion Island, 50 to 75 fathoms.

I place this form under *Menipea*, solely on account of the anterior avicularium; in other respects it might as well be referred to the armed group of *Cellularia*.

(7) *Menipea triseriata*, Busk.

Menipea triseriata, Bk., Brit. Mus. Cat., p. 22, pl. xxiii. figs. 2, 3, 4.

Character.—Zoœcia oblong rectangular (behind), bi- or tri-serial, numerous (twelve to fourteen in the internode). Aperture oval, pointed at bottom, and there partially filled

in by a granulated lamina; one or two marginal spines on each side, above. Oœcia rounded, cucullate, smooth; lip of orifice entire.

Habitat.—Simon's Bay, Cape of Good Hope.

(8) *Menipea cirrata*, Lamouroux.

Menipea cirrata, Lamx., Hist. des Polypes, p. 145; Exp. Méth., p. 7, pl. iv. fig. D; Bk., Brit. Mus. Cat., vol. i. p. 21, pl. xx. figs. 1, 2; Krauss.
Cellaria cirrata, Ell. and Soland.
„ *crispa*, Pallas, Elench.
Sertularia crispa, Gmelin.
„ *cirrata*, Gmelin.
Tubularia cirrata, Esper, Seba.

Character.—Zoœcia pyriform, constricted below, six in each internode, one of the lower usually more or less aborted; usually one large lateral avicularium to each internode; three long, strong, marginal spines. Anterior avicularium single, its upper border toothed

Habitat.—Simon's Bay, Cape of Good Hope.

(9) *Menipea pateriformis*, n. sp. (Pl. V. fig. 4).

Character.—Zoarium branched, branches thick, almost cylindrical, arising from a loose tuft of radical fibres. Zoœcia tri- or quadri-serial, the lateral series facing outwards at a slight angle, oblong, with a regularly oval aperture occupying the upper three-fourths; the margin very thin, smooth and high. A large, prominent, sessile avicularium below the aperture in almost every zoœcium. Oœcia lofty, narrow, surface smooth, entire. Dorsal surface covered with radical tubes.

Habitat.—Station 299, lat. 33° 31′ S., long. 74° 43′ W., 2160 fathoms, blue mud.

3. *Emma*, Gray.

Emma, Gray, Dieffenb. New Zealand, vol. ii. p. 293; Bk., Voy. of Rattles., vol. i. p. 373; Brit. Mus. Cat., p. 27; T. W. Hutton.
Menipea (sp.), Wyv. Thoms.; Hincks.

Character.—Zoœcia in conjoined pairs or triplets in each internode (not opposite); much expanded above and contracted below. Upper part of front occupied by a wide subtriangular bordered area, partially filled in by a granular lamina; and with a suborbicular membranous aperture. A lateral sessile avicularium placed below the level of the aperture.

Emma crystallina, Gray.

Emma crystallina, Bk., Brit. Mus. Cat., vol. i. p. 28, pl. xl.

Character.—Zoœcia in pairs; one to three strong spines on the outer border of the area, of which the middle one is usually the longest and thickest.

Habitat.—Station 161, Port Philip, 33 fathoms, sand.

[Bass Strait, 45 fathoms, Voy. of Rattles.; New Zealand, Dieffenb.; Hooker, Hutton, Lyall; Strait of Magellan, Miss Gatty; Campbell's Island, Hooker.]

4. *Scrupocellaria*, van Beneden.

Scrupocellaria, v. Bened., Recherches, 1844; Hincks.
Bicellaria, sp., Blainv.
Cellularia, sp., Pallas, Johnst., Smitt, &c.
Cellaria, sp., Ell. and Soland., Lamk.
Scruparia, sp., Oken.
Canda, sp., Bk.

Character.—Zoœcia biserial, numerous in each internode, rhomboidal, with a sinus behind; a sessile avicularium on the upper and outer angle, and a vibraculum seated in the dorsal sinus of each zoœcium. Aperture oval or sub-rotund, with marginal spines above; with or without a fornix.

(1) *Scrupocellaria macandrei*, Busk (Pl. XI. fig. 4).

Scrupocellaria macandrei, Bk., Brit. Mus. Cat., vol. i. p. 24, pl. xxiv. figs. 1, 2, 3.

Character.—Zoarium 1 to 2 inches high, branches close, short, strongly serrated. Aperture sub-orbicular; fornix sub-orbicular, with a thick short stem, covering the entire aperture below the semicircular orifice, of which the lower lip appears to be formed by the upper border of the fornix. Border of aperture wide and thick below with a granular surface. Vibracula upright. Oœcia depressed, surface entire.

Habitat.—St. Vincent, Cape Verde Islands, 1070 to 1150 fathoms, mud. St. Paul's Rocks, North Atlantic.

[Coast of Spain, M'Andrew.]

(2) *Scrupocellaria ciliata*, Audouin (Pl. XI. fig. 5).

Crisia ciliata, Audouin, Egypte, Zool., pl. xii. fig. 2.
Scrupocellaria diadema, Bk., Brit. Mus. Cat., vol. i. p. 24, pl. xxviii. figs. 1, 2, 3.

Character.—Zoarium, mostly in one plane, branches rather long feathered. Aperture large, oval, with a thin smooth border; several marginal spines above (often wanting). Fornix with a slender upright pedicle and very irregularly shaped blade. Vibracularia

small, flagella capillary. Oœcia small, cucullate, perforated with one or two transverse rows of punctures. A row of small sessile avicularia in front.

Habitat.—Station 188, lat. 9° 59′ S., long. 139° 42′ E., 28 fathoms, green mud.

[Mediterranean ? Savigny ; Moreton Bay, Voy. of Rattles.; Cape Verde Islands, Miss Gatty.]

(3) *Scrupocellaria ornithorhynchus*, Wyv. Thoms. (sp.) (Pl. XI. fig. 6).

Crisia ornithorhynchus, Wyv. Thoms.
(?) *Scrupocellaria clypeata*, Haswell, Proc. Linn. Soc. New South Wales, 1880, p. 37, pl. i. fig. 6.

Character.—Zoarium small, branches very slender, divaricate. Zoœcia rather distant. Aperture oval, border thin and smooth ; two or three slender, pointed marginal spines on the outer side and one on the inner. Fornix with a wide peduncle, the lamina lobate, rounded below and produced into a more or less pointed lobe above. Vibracularia small, flagella minute.

Habitat.—Off Honoruru, Sandwich Islands, 20 to 40 fathoms.

(4) *Scrupocellaria pilosa*, Audouin (sp.) (Pl. XI. fig. 7).

Crisia pilosa, Savigny, Egypte, pl. xii. fig. 1, Audouin, Expl. i, p. 241.

Character.—Zoarium about 1 inch high, tufted, rather spreading, branches slender. Zoœcia elongated. Aperture small, oval ; border thin but wide at bottom, not granulated. Three or four marginal spines on the outer side and at the top, and two on the inner side. Fornix with the lamina rounded below and tongue-shaped above, longer than the aperture. Vibraculum small and upright.

Habitat.—Station 135A and C, off Inaccessible and Nightingale Islands, 75 and 110 fathoms.

[Mediterranean ? Savigny.]

Notwithstanding the different form of the fornix in the present species, and in that figured by Savigny, the other characters, and especially the length and slenderness of the zoœcia, and the number and length of the delicate marginal spines, leave little room for doubt that the two forms are identical or very closely allied.

In this form radical tubes may sometimes, though rarely, be seen extending from one branch to another, but not directly transversely as in *Canda*.

(5) *Scrupocellaria securifera*, n. sp. (Pl. XI. fig. 2).

Character.—Zoarium irregularly dichotomous, rather straggling. Aperture large, margin rather thick, a strong, short, conical, oral spine on each side. Fornix hatchet-shaped, expanding towards the outer end, which becomes closely applied to or connate

with the outer border of the aperture (forming a transverse bridge). Oœcium large, somewhat flattened in front, much immersed; wall punctured. Vibracularia rather large; flagella simple, setose.

Habitat.—Admiralty Islands.

5. *Canda*, Lamouroux.

Canda, Lamx., Blainv. (pars), d'Orb., Brit. Mus. Cat.
Cellaria (sp.), Lamk.

Character.—Branches biserial, dichotomous, connected by transverse chitinous tubes, inserted at both ends into a vibracularium. No lateral avicularia, and the anterior avicularia, when present, placed on a special median tract or on the summit of the oœcia. A vibracularium lodged in a sinus behind; flagellum short, flattened, not toothed. With or without a pedunculate fornix.

By the removal of *Canda reptans* to its proper place under *Scrupocellaria*, where it was classed by Gray, and is retained by Mr. Hincks,[1] the genus *Canda*, as defined by Lamouroux, becomes a very natural one; and as it exhibits features in common with *Caberea*, viz., in the important respect of the membraniporidan type of the front of the zoœcium as well as in the peculiar mode of branching at each bifurcation, as pointed out by Prof. Smitt,[2] it should be placed together with that genus among the Cellulariadæ.

(1) *Canda arachnoides*, Lamouroux.

Canda arachnoides, Lamx., Hist. des Polyp., p. 132, pl. ii. fig. 6; Exp. méth., p. 5, pl. lxiv. figs. 19–22; Blainv., d'Orb., Palæont. Franç., p. 331; Bk., Voy. of Rattles., vol. i. p. 371, Brit. Mus. Cat., vol. i. p. 26, pl. xxxiii.
Cellaria filifera, Lamk., vol. ii. p. 177.

Character.—Front of zoœcium rhomboidal, aperture large, oval, truncated above; the upper margin recedent with a strong spine on each side, the outer much the larger and articulated; margin beaded; lamina covered with minute crystalline granulations. An irregular series of anterior avicularia which are very prominent, with a flexible basal portion and an acute triangular mandible. Oœcium subglobose, crowned with a sessile avicularium, and having a broad elliptical membranous area in front.

Habitat.—Station 162, off East Moncœur Island, Bass Strait, 38 to 85 fathoms, sand, shells.

[Bass Strait, 45 fathoms, Voy. of Rattles.; Timor, Péron and Lesueur; New Zealand, Dr. Lyall.]

[1] Brit. Mar. Polyz., vol. i. p. 52.

[2] Florid. Bryoz., pt. i. pp. 15–17. It may be remarked that Prof. Smitt has also noticed that a similar mode of branching or gemmation at each bifurcation, obtains in *Cellularia* (*Scrupocellaria*) *cervicornis*.

The anterior avicularia are sometimes aborted throughout a considerable part of an internode, but never entirely so, and in most cases their site is indicated by a pore-like opening. These organs do not appear to be developed in connection with any individual zoœcium, and they might be regarded perhaps rather as an intermediate series of metamorphosed zoœcia.

(2) *Canda simplex*, n. sp. ? (Pl. XIV. fig. 8).

Character.—Zoarium spreading, rather closely reticulate. Frontal area rhomboidal; aperture oval and about half the length of the area; margin not recedent at the top; with a very small spine at each upper angle; margin and lamina thin, indistinctly and finely granulated. No anterior avicularia except on the summit of the oœcia. Oœcia subglobose with a small membranous area in front.

Habitat.—Station 44, lat. 37° 25′ N., long. 71° 40′ W., 1700 fathoms, blue mud.

[Gulf of Mexico, 2 to 15 fathoms.]

In the Challenger collection this form is represented by only one or two minute fragments, in pretty good condition, but which would have been insufficient for its determination, had I not been in possession of specimens of obviously the same form from the Gulf of Mexico, which have enabled me to draw up the above diagnosis. The only difference between the form procured at a depth of 1700 fathoms, and that which had lived at about 12 fathoms, is in the much greater delicacy and slenderness of the former. It is a remarkable circumstance that a second species of *Canda* also occurs in the Gulf of Mexico, which has been described and figured by Prof. Smitt[1] under the not very well chosen name of *Caberea retiformis*. This was procured by Count Pourtales, at a depth of 68 to 270 fathoms. It differs from both the species above described in having a large reniform fornix, and from *Canda arachnoides* in having no avicularia whatever. Of this form I have a good many specimens, procured on John Adam's Bank, North Atlantic, on the voyage of H.M.S. "Herald," which agree in all particulars with Prof. Smitt's description.

6. *Nellia*, Busk.

Salicornaria (pars), Bk., Voy. of Rattles., vol. i. p. 367.
Nellia, Bk., Brit. Mus. Cat., vol. i. p. 18; Smitt; Macgilliv.

Character.—Zoarium articulated, internodes short quadrangular. Zoœcia quadriserial, front flat or convex at bottom. The greater part of the front occupied by a large aperture; border prominent, especially above, smooth and thick. Orifice quite at the summit. Oœcia absent.

[1] Florid. Bryoz., pt. i. p. 16, pl. v. figs. 43–46.

(1) *Nellia oculata*, Busk.

Nellia oculata, Bk., Brit. Mus. Cat., vol. i. p. 18, pl. lxiv. fig. 6, pl. lxv. fig. 4.
„ „ Smitt, Florid. Bryoz., vol. ii. p. 3, pl. i. figs. 53, 54.
„ „ Macgilliv., Nat. Hist. Vict., Dec. v. p. 51, pl. xlix. fig. 5.

Character.—Zoarium 2 to 3 inches high, growth tufted; internodes very uniform in length, usually with four or five zoœcia on each face. Outline of front oblong, rounded at top, truncate below. Aperture oval, with a slight constriction above. Two raised papilliform avicularian prominences on each side below the aperture.

Habitat.—Station 190, lat. 8° 56′ S., long. 136° 5′ E., 45 fathoms, green mud. Station 188, lat. 9° 59′ S., long. 139° 42′ E., 28 fathoms, green mud. Station 208, lat. 11° 37′ N., long. 123° 31′ E., 18 fathoms, blue mud. Station 148, lat. 46° 47′ S., long. 51° 37′ E., 210 to 550 fathoms. Off Bahia, 10 to 40 fathoms. Station 151, off Heard Island, 75 fathoms, volcanic mud.

[Torres Strait, Voy. of Rattles.; Coast of Arracan, Walker; Trincomalee, Johnst.; Gulf of Florida, Pourtalès.]

(2) *Nellia simplex*, Busk (Pl. V. fig. 6).

Nellia simplex, Bk., Brit. Mus. Cat., p. 19, pl. lxv. fig. 1.

Habitat.—Station 87, lat. 25° 49′ N., long. 20° 12′ W., 1675 fathoms, rock.

7. *Caberea*, Lamouroux.

Caberea, Lamx., Blainv., d'Orb. (sp.), Gray, Smitt, Busk, Hincks, &c.
Cellaria (pars), Lamk., Audouin.
Flustra and *Cellularia* (pars), Fleming, Johnst.
Crisia (pars), Audouin.
Selbia, *Flabellaria*, Gray.
Canda (sp.), d'Orb.

Character.—Zoarium very variable in dimensions; branches more or less regularly dichotomous; flabellate, cæspitose or radiate. Zoœcia bi-, tri-, or multiserial; anterior face membraniporidan (*i.e.*, showing a large area with an elevated margin, and a membranous aperture of greater or less size); furnished or not with a fornix, and usually having two oral spines on the outer side and two on the inner, one of which arises from or in common with the peduncle of the fornix. An extrangular avicularium to each of the outer zoœcia, and an anterior one on the inner side or both sides of the median zoœcia; the mandible of these avicularia always rounded or obtuse. The back of the branches more or less completely covered with a succession of large interdigitating vibracularia, whose seta is always toothed, and when at rest is received in a groove on the back of the vibracularium. A radical tube enters the under side of each vibracularium, so that the back of the branches is usually completely covered by tubes.

The genus *Caberea*, together with the aberrant form *Amastigia*, constitutes a very peculiar group. Formerly regarded by myself, and, I believe, still considered by all writers (including one of the latest and most careful[1]) as unarticulated, I have now satisfied myself that such is not exactly the case. Though less distinctly divided into segments or internodes, the zoarium in *Caberea* is undoubtedly irregularly segmented, and especially is it the case that at each bifurcation one of the branches of the fork, which may perhaps be regarded as a lateral branch, is always discontinuous, though from the close manner in which the zoœcia are approximated, the joint is often very inconspicuous, and allows of but limited flexion. The segmentation, whatever that character may be worth, which is perhaps not much, except as convenient in an artificial classification, is in any case sufficiently distinct to warrant the collocation of *Caberea* with its natural allies among the Cellulariadæ, and especially of course with *Scrupocellaria*.

Of this genus I am acquainted with seven or eight species, of which, however, not more than three or four can be certainly identified from any published descriptions.

The Challenger collection affords six, of which four appear hitherto to have been undescribed. Of the six species, three occur in the Australian region (including New Zealand), one in what may be termed the Kerguelen region, and two in the south-western Atlantic region.

§ *a. fornicatæ.*

1. *Caberea rostrata*, n. sp. (Pl. XXXII. fig. 4).

? *Selbia zelanica*, Gray, Dieffenb. N. Z., vol. ii. p. 292.

Character.—Zoarium radiate or flabelliform, about 1 inch in diameter; branches long, straight, and close. Zoœcia broadly oval. Area large, with a thin even margin. Aperture large. Fornix short, small, spatulate, with a thick peduncle; blade rather produced upwards; peduncular spine very thick, long; a short, thick, conical, ascending spine on the outer angle. Oœcium sub-cucullate; wall entire, smooth. Besides the usual series of small anterior avicularia, occasionally one of enormous size and rostriform projects from the median line directly forwards, having a strong curved acute mandible.

Habitat.—Station 167, lat. 39° 32′ S., long. 171° 48′ E., 150 fathoms, blue mud.

2. *Caberea crassimarginata*, n. sp. (Pl. XI. fig. 1).

Character.—Zoarium rather straggling, regularly dichotomous. Zoœcia biserial. Area elongated elliptical, with a very thick and rounded granular border, leaving an elongated narrow aperture. One or two oral spines on the outer side, and one on the inner (peduncular). Fornix bilobed, the lower lobe much elongated and narrow, the

[1] Hincks, Brit. Mar. Polyz., vol. i. p. 57.

upper broad and truncated above, and often with an ascending process at the outer angle. Anterior avicularia rather large, angular very small and often absent. Œcium large, lofty, contracted below, surface very smooth and polished.

Habitat.—Station 320, lat. 37° 17′ S., long. 53° 52′ W., 600 fathoms, green sand.

(3) *Caberea darwinii*, Busk (Pl. XXXII. fig. 6).

Caberea patagonica, Bk., Brit. Mus. Cat., vol. i. p. 38, pl. xxxviii. (nec *Caberea boryi*).
„ *zelanica*, Bk., Voy. of Rattles., vol. i. p. 378.

Character.—Zoarium expanding, about 1 inch high, flabelliform. Zoœcia elongate. Area large, irregularly oval, wide above, contracted and almost pointed below, the greater part filled in with a finely granular lamina, not continuous across at the top. Aperture open at top and descending about half the length of the area. One or two strong oral spines on the outer side, and one beside the peduncular spine on the inner. Fornix irregularly oval or reniform, blade nearly as large as the aperture. Median avicularium close to and above the peduncle of the fornix, with which it is connate. Œcium much depressed, bordered. Vibracularia very large.

Habitat.—Station 135c, off Nightingale Island, Tristan da Cunha, 110 and 150 fathoms. Station 142, lat. 35° 4′ S., long. 18° 37′ E., 150 fathoms, green sand. Station 148, lat. 46° 47′ S., long. 51° 37′ E., 210 to 500 fathoms, hard ground, gravel, shells. Station 149h, i, k, Christmas Harbour, Kerguelen, 45 to 127 fathoms. Off Prince Edward Island, 80 to 150 fathoms. Off Marion Island, 50 to 75 fathoms.

[Cumberland Island, Voy. of Rattles.; New Zealand, Hooker; Strait of Magellan, &c. Darwin.]

It is this form that is represented in the Brit. Mus. Cat., pl. xxxviii., under the name of *Cabarea boryi* (on the plate, *Cabarea patagonica*), but as it is by no means clear (though not improbable) that it is identical with M. d'Orbigny's *Canda* (*Caberea*) *patagonica*, Voy. en Amér. Mérid., p. 9, pl. ii. figs. 5–9, I have thought it better not to adopt that appellation, which may nevertheless turn out to be applicable; and instead of the term *zelanica* which I also at one time applied to it (under the supposition that it was the *Selbia zelanica* of Gray), I have given it the name of the illustrious naturalist to whom I was indebted for the first specimens that came under my notice. The *Selbia zelanica* of Dr. Gray I now propose to term *Caberea lyallii*, having fully satisfied myself that that New Zealand species is quite distinct from *Caberea boryi*, under which appellation both I and others have confounded two or three quite distinct species. So far as I know at present, the true *Caberea boryi* of Audouin is confined to the Mediterranean and Atlantic regions, as far north as our own coast, and as far south, in all probability, as the Cape (Algoa Bay).

(4) *Caberea rudis*, Busk.

Caberea rudis, Bk., Brit. Mus. Cat., vol. i. p. 38, pl. xlvi.; pl. xxxvi. figs. 1, 2; Voy. of Rattles., vol. i. p. 377.

Character.—Zoarium broad, frondose, 2 or 3 inches high; branches disposed in the same plane, flat, thick, and about $\frac{1}{8}$th inch wide. Zoœcia (viewed behind) rhomboidal. Aperture oval, margin much thickened; a strong oral spine on each side in the central cells; three strong and long spines on the outer side, and one on the inner in the marginal cells. Fornix spatulate, wide, with a very broad peduncle. Two small avicularia in front below the aperture in the central cells, and a single large avicularium below the aperture in the marginal ones. Vibracula slender, with very delicate walls; seta of moderate size, serrated.

Habitat.—Station 161, off entrance to Port Philip, 33 fathoms, sand.

[Bass Strait, Voy. of Rattles.]

In the Brit. Mus. Cat. the seta is erroneously described as not serrated.

(5) *Caberea minima*, n. sp. (Pl. XXXII. fig. 5).

Character.—Zoarium very small, about $\frac{1}{2}$ inch wide, fan-shaped; branches short, irregularly dichotomous. Zoœcia, area nearly circular. Aperture almost as large as the area, entirely open above; lamina smooth and very delicate. Fornix with a subcordate or circular blade, apparently articulated to a very wide and thick peduncle, and standing some distance in front of the aperture. Peduncular spine very strong; median avicularium arising immediately above the base of the peduncle.

Habitat.—Station 315, lat. 51° 40′ S., long. 57° 50′ W., 5 to 12 fathoms, sand and gravel.

[Falkland Islands.]

§ *β. apertæ.*

(6) *Caberea lata*, Busk (Pl. XI. fig. 3).

Caberea lata, Bk., Voy. of Rattles., vol. i. p. 378; Brit. Mus. Cat., p. 39, pl. xlvii.

Character.—Zoarium flabellate, branches rather wide, broadly truncate. Zoœcia, area occupying the entire front, margin thin and smooth. Aperture elliptical, large. A small avicularium (often aborted) at each lower angle of the aperture. Often a short spine at the upper and outer angle of the lateral cells, each of which is also furnished with a rather large extrangular avicularium. Vibracularia very long, closely approximated, and very

deeply grooved; setæ long and strong. Radical tubes forming a dense elevated keel in the middle of the branch behind (none on the sides).

Habitat.—Station 190, lat. 8° 56′ S., long. 136° 5′ E., 45 fathoms, green mud. Station 186, lat. 10° 30′ S., long. 142° 18′ E., 8 fathoms, coral mud.

[Australia, Voy. of Rattles., New Zealand, Hooker.]

This species varies a good deal; the small anterior avicularium is sometimes absent or only rudimentary, and in some cases the lateral extrangular avicularium is very minute or inconspicuous, whilst in others it may attain a very considerable size. When the growth occurs in the biserial form it would be easy to confound it with *Caberea hookeri*.

Family VI. Bicellariadæ.

Bicellariadæ, Bk., Brit. Mus. Cat., vol. i. p. 41; Voy. of Rattles., vol. i. p. 373.
Bicellariæ, Smitt.
Bugulidæ, Gray.
Bicellariidæ, Bk., Crag. Polyz. (pars); Hincks.
Acamarchisidæ, d'Orb.

Character.—Zoarium continuous, erect, phytoid, divided into ligulate, bi-multiserial branches; affixed by radical fibres, and sometimes supported on a long chitinous tubular stem, which represents a modified radical tube. Avicularia, when present, pedunculate capitate, articulated or not. Zoœcia with a wide oblique aperture, all facing in the same direction.

The Family here contains the following genera:—

1. *Bicellaria*, Blainville.
   - (1) *Bicellaria navicularis*, n. sp. (Pl. VII. fig. 2).
   - (2) *Bicellaria pectogemma*, Goldstein (Pl. VII. fig. 1).
   - (3) *Bicellaria infundibulata*, n. sp. (Pl. VI. fig. 2).
   - (4) *Bicellaria bella*, n. sp. (Pl. VI. fig. 3).
   - (5) *Bicellaria moluccensis*, n. sp. (Pl. VI. fig. 4).
   - (6) *Bicellaria glabra* (Hincks) (Pl. VI. fig. 1).
   - (7) *Bicellaria macilenta*, n. sp. (Pl. XXXII. fig. 1).

2. *Bugula*, Oken.

   § *a*.
   - (1) *Bugula versicolor*, n. sp. (Pl. III. fig. 4).
   - (2) *Bugula leontodon*, n. sp. (Pl. X. fig. 3).
   - (3) *Bugula sinuosa*, n. sp. (Pl. X. fig. 2).
   - (4) *Bugula mirabilis*, n. sp. (Pl. X. fig. 1).

§ β.

(5) *Bugula reticulata*, n. sp. (Pl. VIII. fig. 3).

(6) *Bugula bicornis*, n. sp. (Pl. IX. fig. 1).

§ γ.

(7) *Bugula margaritifera*, n. sp. (Pl. VIII. fig. 4).

§ δ.

(8) *Bugula neritina* (Linn).

(9) *Bugula longissima*, n. sp. (Pl. XXXI. fig. 7).

3. *Kinetoskias*, Koren and Daniellsen.

(1) *Kinetoskias cyathus* (Wyv. Thoms.) (Pl. VIII. fig. 1).

(2) *Kinetoskias pocillum*, n. sp. (Pl. VIII. fig. 2).

4. *Ichthyaria*, n. gen.

Ichthyaria oculata, n. sp. (Pl. XIII. fig. 7).

1. *Bicellaria*, Blainville.

Bicellaria, Blainv., Gray, Johnst., Brit. Mus. Cat., Hincks, &c.
Cellularia (pars), Fleming, Pallas.
Cellaria (sp.), Solander, Lamx.
Crisia (pars), Lamx.
Bugula (pars), Oken.
Stirparia, sp., Goldst.; Hincks.

Character.—Zoœcia turbinate or subturbinate, biserial, the two series more or less disjunct. Aperture large, directed obliquely upwards. Avicularia when present usually pedunculate and capitate or trumpet-shaped; rarely sessile, not articulated, and placed either on the anterior or posterior aspect.

(1) *Bicellaria navicularis*, n. sp. (Pl. VII. fig. 2).

Character.—Aperture boat-shaped, the wider end outwards; a small funnel-shaped, shortly pedunculate avicularium at the inner end, in front of the aperture. A long digitiform process, produced from the summit of the zoœcium below the border of the aperture, from which arise four to eight (usually six) long delicate curved spines, articulated chiefly along the posterior side of the digitiform process. Oœcium (fig. 2*b*) rounded, depressed, cucullate, recumbent, at the outer border of the aperture. A small solitary dorsal spine.

Habitat.—Station 122, Barra Grande, Brazil, lat. 9° 5′ S., long. 34° 50′ W., 32 to 400 fathoms, red mud. Station 332, lat. 37° 29′ S., long. 27° 31′ W., 2200 fathoms, Globigerina ooze.

The digitiform process, which forms such a striking character in this species, is represented in *Bicellaria tuba* (Brit. Mus. Cat., p. 42, pl. xxxi.) by a smaller process of the same kind. It is a simple continuation of the zoœcial cavity, and the secondary spines arising from it are articulated at the base. The most marked peculiarity in *Bicellaria naviculoris* is the small funnel-shaped avicularium placed in front of the lower edge of the aperture; not unfrequently there is also a second avicularium of the same kind in front of the upper edge of the aperture. A specimen from 400 fathoms, prepared by Mr. Moseley, has the zoœcia of much larger size than the others.

(2) *Bicellaria pectogemma*, Goldstein (Pl. VII. fig. 1).

Bicellaria pectogemma, Goldst., Proc. Roy. Soc. Vict., June 9, 1881, p. 4, pl. i. figs. 2–2*a*.

Character.—Aperture oval, with a much raised, thin, spatulate margin. Zoœcium attenuated into a very long slender tube. A series of four to six long, curved, very slender spines rising from the back and outer side of the zoœcium, and a small dorsal spine near the rachis. Oœcium large, rounded, quite recumbent, placed at the outer end of the aperture. Avicularia very various in size, but all long, trumpet-shaped, arising from the back of the zoœcia.

Habitat.—Station 145, lat. 46° 48′ S., long 37° 49′ E., 150 to 310 fathoms. Station 150, lat. 52° 4′ S., long. 71° 22′ E., 150 fathoms, coarse gravel. Station 151, off Heard Island, 75 fathoms, volcanic mud.

At first sight resembling *Bicellaria tuba*, Brit. Mus. Cat., p. 42, pl. xxxi., *Bicellaria pectogemma* differs in the more elongated form of the aperture and the absence of the short, digitiform, spiniferous process possessed by the former. The avicularia are alike in both. It should be remarked that the specimens from the two latter localities given above, and from shallower water, are considerably smaller than those from Station 145.

(3) *Bicellaria infundibulata*, n. sp. (Pl. VI. fig. 2).

Character.—Zoœcia infundibuliform. Aperture rounded, expanding outwards; outer border obtusely angular and arched in the middle; one to three long, slender, articulated spines above or behind the aperture (sometimes absent); a minute dorsal spine near the rachis. Oœcia globose, recumbent, placed beyond the aperture of special zoœcia, which arise by a long tubular prolongation from the back of one of the others, from the same spot from which the avicularia spring, and which may doubtless be a modification of the same process. Avicularia of two kinds: one (rare) long, slender, trumpet-shaped, the other capitate, shortly pedunculate; both articulated on the dorsum of a zoœcium.

Habitat.—Station 147, lat. 46° 16′ S., long. 48° 27′ E., 1600 fathoms, Diatom ooze. Station 156, lat. 62° 26′ S., long. 95° 44′ E., 1975 fathoms, Diatom ooze.

The trumpet-shaped avicularia are but rarely developed; they differ from those on *Bicellaria spatulata* in their much smaller size and the more oblique truncation of the terminal surface; all the avicularia have a peculiar vertical posture. The specimens from Station 156 differ in some respects from the others; they are extremely soft and flaccid, containing apparently but very little calcareous matter; and the zoœcia are usually without any spines or with a very short and blunt one behind; the angularity, moreover, of the outer border of the aperture is more marked, and the dorsal avicularia rather larger. This may be regarded as a variety, *flaccida*. The size of the zoœcia is much greater in the var. *flaccida*, in which they appear to attain the greatest dimensions as yet noticed in the genus (0″·06 × ·02), the former dimension being the length of the tubular portion between the two joints, and the latter being the width of the body.

(4) *Bicellaria bella*, n. sp. (Pl. VI. fig. 3).

Character.—Zoarium about 1½ to 2 inches high; branches irregularly forked, with short lateral feathered secondary branches. Zoœcia tubular, very long, and slender below, suddenly widely expanding above with an oblique, irregularly angular aperture, which is prolonged a short way at the outer angle into a digitiform process which projects in front and supports usually six very long curved spines; and on the back of the zoœcium is a row of six to eight also very long spines curving forwards. A small infundibuliform, shortly pedunculate, erect, avicularium (fig. 3*b*) is articulated close below the inner border of the aperture in front; sometimes a second avicularium of the same kind is found on the front of the same zoœcium, and occasionally one of rather smaller size may be seen attached to the side of the digitiform process near its point.

Habitat.—Station 196, lat. 0° 48′ S., long. 126° 58′ E., 825 fathoms, hard ground.

(5) *Bicellaria moluccensis*, n. sp. (Pl. VI. fig. 4).

Character.—Zoarium 3 or 4 inches high, branches long, straight, forked at an acute angle, feathered. Zoœcia tubular, length between the nodes about 0″·03; body of zoœcia about 0″·02 × ·01 to ·015. Aperture ovate, expanded towards the upper part; upper border wavy. A digital process projecting rather in front, supporting four or five long, curved spines. A long articulated spine behind towards the outer end of the zoœcium, and a small, upright one near the inner end. A large, circular cup or disc in the middle of the dorsum, from which springs, with a much contracted base, a long tubiform avicularium, of nearly equal calibre throughout, and with the wall very faintly ringed.

Oœcium lofty, helmet-shaped, fixed at the upper border of the aperture, and with a slightly thickened and everted lip.

Habitat.—Station 196, lat. 0° 48′ S., long. 126° 58′ E., 825 fathoms, hard ground.

One great peculiarity of this species is the invariable origin of the avicularium from the middle of a cupped disc on the dorsum of the zoœcium; close to the base the tube is very much and suddenly constricted, but there is no true articulation; from this part to the extremity the tube is of very equal diameter, not gradually enlarging as in *Bicellaria spatulata*, and the terminal portion is not very much expanded. The rostral portion forms an oval cup, with a thin membranous border, and the mandible is obtuse and fringed with a very thin membrane, representing more the lid of a trap than an organ for prehension, as it has no incurved acute denticle at the end, such as is usually present. The internal arrangement of the avicularium is however exactly like that in the avicularium of *Bicellaria pectogemma*, Pl. VII. fig. 1.

(6) *Bicellaria glabra*, Hincks (sp.) (Pl. VI. fig. 1).

Stirparia glabra, Hincks, Ann. and Mag. Nat. Hist., ser. v. vol. xi. p. 195, 1883.

Character.—Zoœcia disposed in a short, dense, sub-triangular spike, supported by a very long, slender, tubular, jointed, chitinous stem, which bifurcates irregularly. Zoœcia infundibuliform, shortly tubular below. Aperture sub-triangular. Avicularia small, pedunculate, sparsely distributed on the front of some of the zoœcia, close below the aperture. The two or three lowest zoœcia in each capitulum have from five to seven reclinate spines on each side. The upper ones usually only a single ascending spine on each side. Oœcia (seen only on a few of the lower zoœcia) globose, with an acute keel in front.

Habitat.—Off Bahia, 10 to 12 fathoms.

[Western Australia, Miss Gore.]

Only a single, not very perfect, specimen of this very curious form occurs in the collection, having apparently been selected and placed aside, in a small separate tube, from the rest of the gathering procured in the same locality.

The curious peduncle is very distinctly divided into numerous internodes of irregular lengths, and is probably of the same nature as that of *Kinetoskias cyathus*.[1]

(7) *Bicellaria macilenta*, n. sp. (Pl. XXXII. fig. 1).

Character.—Zoarium about 1 to 2 inches high, of tufted growth; branches short, feathered. Zoœcia, body narrow, subtubular, very widely expanded at the

[1] Since the above was in type, Mr. Hincks has described, apparently, the same form under the name of *Stirparia glabra*, and gives a full account of the peculiar structure on the zoarium and its stem from better materials than those at my command.

aperture, which is more or less triangular or sub-rhomboidal; the outer angle running into the digital process, which is continued from the external angle, and supports on the upper side four or five long curved articulated spines. Two long articulated dorsal spines near the upper part of the zoœcium and a slenderer one near the rachis. No avicularia. The median cell at a bifurcation has a triangular aperture, the upper border arched in the middle, and no digital process. Oœcium helmet-shaped, with a slightly thickened border.

Habitat.—Station 196, lat. 0° 48′ S., long. 126° 58′ E., 825 fathoms, hard ground.

Brought up in the same haul together with *Bicellaria bella* and *Bicellaria moluccensis*, the present form is indistinguishable, by the naked eye, from the former of these species, and for some time I was inclined to regard it as a variety; but notwithstanding the several points in which they show strong similarity, in all important respects they differ very widely. I may add that the comparison has been made with abundance of specimens, and the distinction appears to me to rest on ample grounds.

The chief points of resemblance may be stated to be:—

1. The general habit, which is precisely the same, including the mode in which the numerous spines arch over the front of the branches, though these appendages are less numerous in *Bicellaria macilenta* than in *Bicellaria bella*.

2. The outer angle of the aperture is prolonged into the base of the digital process; but in *Bicellaria macilenta* this prolongation is more extensive.

3. The curious angular curvatures of what may be termed the rachis, which forms an abrupt angle at the base of the body of each zoarium.

The similarity in form of the oœcia might also be cited; but as that organ presents exactly the same appearance in several other species, it is not a distinctive character of any value in the present case.

The differences are:—

1. The form of the body of the zoœcium, which in *Bicellaria macilenta* is very much narrower and almost cylindrical.

2. The absence of a digital process in the median zoœcium at a bifurcation, whilst in *Bicellaria bella* that, or rather it may be said, the two median zoœcia, in the same situation, are furnished with a digital process, projecting directly in front, owing to the circumstance that the zoœcia in question look sideways and not directly in front, as in *Bicellaria macilenta*.

3. The total absence of avicularia of any kind in *Bicellaria macilenta*.

2. *Bugula*, Oken.

Bugula, Oken, Busk, Smitt, Gray (sp.), Smitt, Hincks, &c.
Acamarchis, Lamx., Blainv., d'Orb. (sp.).
Crisia (sp.), Lamx.

Cellularia (sp.), Pallas, Johnst., &c.
Cellaria (sp.), Ell. and Soland.
Bugulina, Crisalaria, Flabellaria, Gray.
Avicella, v. Bened.
Ornithopora, Ornithoporina, Cellularia (pars), d'Orb.
Bicellaria (sp.), v. Bened.
Halophila (sp.), Bk.

Character.—Zoœcia bi- or multiserial, closely contiguous and united, arising in continuous series each from the back of the subjacent one. Aperture partial or entire. Avicularia when present always on the anterior aspect of the zoœcia.

In order to include several of the species in the present collection, and to avoid the creation of one or more new genera, I have thought it better in this catalogue so to modify the definition of *Bugula* as to admit of these, for the most part, new forms being placed in it. And this wider definition, resting mainly as respects the distinction of *Bugula* from *Bicellaria* upon the mode of gemmation and inter-connection of the zoœcia, allows of *Halophila* being included under it, which in fact differs in no essential particular from such an unarmed form, for instance, as *Bugula neritina*.

The group, however, as thus made up, includes several apparently distinct types, which will probably at some time be thought of at least sub-generic value.

To indicate what is meant by these sub-generic or generic groups, I venture to propose the following scheme.

§ *α*. Those species in which in one part of the zoarium the branches are biserial and in another tri-, or quadri-serial, the intermediate series only including the fertile zoœcia, the oœcia being lodged within the superjacent zoœcium, whilst the avicularium is subsessile at the bottom of the zoœcium in front.

1. *Bugula versicolor*, n. sp. (Pl. III. fig. 4).
2. *Bugula leontodon*, n. sp. (Pl. X. fig. 3).
3. *Bugula sinuosa*, n. sp. (Pl. X. fig. 2).
4. *Bugula mirabilis*, n. sp. (Pl. X. fig. 1).

§ *β*. Those in which the zoœcia are much attenuated downwards, and the avicularia are supported on very long, flexible, and probably contractile pedicels.

5. *Bugula reticulata*, n. sp. (Pl. VIII. fig. 3).
6. *Bugula bicornis*, n. sp. (Pl. IX. fig. 1).

§ *γ*. Those in which the zoœcia are usually oblong and little or not at all attenuated downwards, and have shortly pedunculate avicularia, usually articulated to the margin of the aperture, such as *Bicellaria flabellata, turbinata, avicularia, plumosa*, &c.

7. *Bugula margaritifera*, n. sp. (Pl. VIII. fig. 4).

§ δ. Those in which the zoœcia are wholly unarmed, such as *Bugula* (*Halophila*) *johnstoniæ*.

8. *Bugula neritina* (Linné).
9. *Bugula* (*Halophila*) *longissima*, n. sp. (Pl. XXXI. fig. 7).

It may also be observed that the first and second of these groups consist almost exclusively of very deep water forms, the shallowest being 150 fathoms for *Bugula sinuosa*, whilst the depths from which the other species, included in those groups, were brought up was on the average not less than 2000 fathoms. They would appear therefore to constitute a distinctively abyssal type.

The Challenger collection contributes eight new species to this genus, of which perhaps from sixteen to twenty were previously known.

Of these, two occurred in the South Atlantic region, two in the Kerguelen, or South Indian region, two in the North Atlantic, and one in both the South Atlantic and South Pacific regions.

The least depth from which any one of them was brought up is 60–75 fathoms; the depths from which all the rest were procured varying from 400 to 2500 fathoms; and as the species from 600 fathoms occurred also in the South Pacific, at a depth of 2160 fathoms, they may, as above said, be regarded as specially deep water forms; on which account, doubtless, they have hitherto escaped notice.

Though none appear to have been met with in the Australian region, *Bugula bicornis* occurred but very little to the west of it. The group affords a striking instance of the comparatively large size and free growth, and at the same time of the extremely delicate structure, characteristic it may almost be said of the Polyzoa that live in the tranquil depths of the ocean.

(1) *Bugula versicolor*, n. sp. (Pl. III. fig. 4).

Character.—Zoarium about 2 inches high; coloured blue and purple;[1] forked, and from the upper side only of each branch straight secondary branches arise in the same plane and parallel with each other. (Candelabriform). Zoœcia bi- or tri- serial, oblong, nearly straight on the outer side, sinuated on the inner. Aperture entire, margin thick, smooth. Oœcia globose, usually seated on one of the median zoœcia in the triserial branches, and enclosed within the superjacent zoœcium, which is widely dilated for its reception.

Habitat.—Station 23, Sombrero Island, 450 fathoms, Globigerina ooze. Station 122, lat. 9° 5′ S., long. 34° 50′ W., 350 fathoms, red mud.

[1] This colour has remained permanent in a wet preparation up to the present time (1884).

(2) *Bugula leontodon*, n. sp. (Pl. X. fig. 3).

Character.—Zoarium composed of stout, straight, long furcate branches, several inches high. Zoœcia bi- or tri-serial, elongated ovate, constricted at the base, but not tubular. Aperture occupying the entire front. Two or three strong curved tooth-like processes project inwards from one or both sides of the aperture. Avicularia subsessile, subglobose, seated on the apertural membrane near the lower border.

Habitat.—Station 3, lat. 25° 45′ N., long. 20° 14′ W., 1525 fathoms, hard ground.

(3) *Bugula sinuosa*, n. sp. (Pl. X. fig. 2).

Character.—Zoarium several inches high ; branches strong, forked, spreading, straight, bi- or quadri- serial. Zoœcia elongated fusiform (viewed behind), constricted quite at their origin but not tubular. Aperture occupying the whole of the front. A blunt spinous process at the upper angle of each of the zoœcia in the intermediate series, and only on the outer angle in the lateral. Avicularia subsessile, subglobose, situated on the outer side quite at the bottom of the lateral zoœcia only.

Habitat.—Prince Edward Island, 80 to 150 fathoms.

Though closely allied to *Bugula mirabilis*, the differences between the two appear to be quite sufficient to justify their being regarded as specifically distinct. A single specimen only occurs in the collection.

(4) *Bugula mirabilis*, n. sp. (Pl. X. fig. 1).

Character.—Zoarium several inches high, spreading, composed of thick, straight, bifurcating branches. Zoœcia bi -or tri-serial, elongated, narrow, of very uniform breadth, except quite at the bottom. The aperture occupies four-fifths of the length, and is pointed at the bottom; the upper border rounded and quite simple. Avicularia subsessile, pyriform, with a very short peduncle articulated to the front of the zoœcium, immediately below the aperture, and slightly to one side. The fertile zoœcia form an intermediate or median series, in which they alternate with those in the lateral series, which are thus in pairs on the same level.

Habitat.—Station 89, lat. 22° 18′ N., long. 22° 2′ W., 2400 fathoms, Globigerina ooze.

A very remarkable dimorphous form, as it may be termed. The growth commences with a stem, composed of a *fasciculus* of radical fibres, and the zoarium at the lower part is constituted of slender divaricate biserial branches, whilst in the upper portions of the growth the branches are much thicker and triserial.

Whether all the zoœcia in the middle series are fertile is not quite certain, but as it is only in some of these that the oœcia are developed, it may be supposed that all may

in time be similarly provided. The avicularia resemble those of *Bugula margaritifera* in their subsessile mode of articulation, but differ in their pyriform shape, larger size, and position on the front of the zoœcium below the aperture, and not upon the margin as in that species.

§ β.

(5) *Bugula reticulata*, n. sp. (Pl. VIII. fig. 3).

Character.—Zoarium composed of long, straggling, distant branches, connected by transverse, delicate, calcified, jointed tubes, which appear to issue from the upper and back part of a zoœcium in one of two contiguous branches, and to attach themselves to one in the other branch, either by a discoid expansion of the tube or by tendril-like claspers. Zoœcia elongated, subtubular below. The frontal aperture occupies from one-half to two-thirds of the length. Either with or without a marginal spine at each upper angle. A pedunculated avicularium of small size is articulated by a long flexible pedicel to a rounded opening close below the aperture in front. Oœcia large, lofty cucullate.

Habitat.—Station 147, lat. 46° 16′ S., long. 48° 27′ E., 1600 fathoms, Diatom ooze. Station 320, lat. 37° 17′ S., long. 53° 52′ W., 600 fathoms, green sand. Station 299, lat. 33° 31′ S., long. 74° 43′ W., 2160 fathoms, blue mud. Station 303, lat. 45° 31′ S., long. 78° 9′ W., 1325 fathoms, Globigerina ooze.

Var. α, *unicornis* (Pl. IX. fig. 2).

Many of the zoœcia have a tubular cylindrical spine arising from the back near the top.

Habitat.—Station 101, lat. 5° 48′ N., long. 14° 20′ W., 2500 fathoms, blue mud. Station 106, lat. 1° 47′ N., long. 24° 26′ W., 1850 fathoms, Globigerina ooze. Station 104, lat. 2° 25′ N., long. 20° 1′ W., 2500 fathoms, Globigerina ooze. Station 68, lat. 38° 3′ N., long. 39° 19′ W., 2175 fathoms, Globigerina ooze.

The peculiar dorsal hollow spine is probably only a modified or undeveloped connecting tube. A pedunculate avicularium, exactly like those seated on the zoœcia, may sometimes be seen on one of the transverse connecting tubes above described.

(6) *Bugula bicornis*, n. sp. (Pl. IX. fig. 1).

Character.—Zoarium several inches high, composed of very long branches. Zoœcia elongated, wide above and subtubular below, each arising from nearly the middle of the back of the preceding one. Aperture elliptical, occupying about two-thirds of the front; the sides produced at each upper angle into a large hollow, conical horn. Two avicularia

with very long tubular pedicels arise from the front of each zoœcium; one much larger than the other, and of a different form, arises low down from the tubular prolongation of the cell, and the other much smaller from the front, close below the aperture. Numerous slender radical or clasping tubes arise from the backs of the zoœcia.

Habitat.—Station 157, lat. 53° 55′ S., long. 108° 35′ E., 1950 fathoms, Diatom ooze.

The structure of this magnificent species is of extreme delicacy, so much so indeed that it is difficult to discern the transition from the diaphanous membrane which covers in the frontal aperture to the cell-wall proper; both textures are as transparent as glass and excessively thin. The avicularia are of two distinct kinds, one of each being attached normally to every zoœcium. The larger kind is elongated, and when the mandible is thrown back a digitiform process protrudes (fig. 1*e*). This form of avicularium is supported on a very long jointed, tubular, flexible, peduncle, which in the living state is probably cylindrical, but, perhaps from the action of the alcohol, it usually appears flattened and often thrown into regular zig-zag folds, leading to the suspicion that it may contain a contractile element. The wall of the peduncle of both kinds of avicularia is very finely ringed. The numerous jointed tubular threads proceeding from the back of the zoœcia appear to be of the same nature as those which connect the branches in *Bicellaria reticulata*, from which they differ, however, in their smaller diameter, and in their never, apparently, acting as connectives. Each of these tubes terminates, as it would seem, in a very delicate, but still jointed or segmented hollow filament, upon which may often be seen Globigerina shells and other Foraminifera hanging. It may be supposed, therefore, that the zoarium in its natural state lies prostrate on the ooze, and is affixed by numerous points as well as by a central peduncle.

The polypide has eighteen or twenty tentacles, and appears to be capable of being entirely protruded to a considerable distance; though how this protrusion is effected is very difficult of explanation.

§ γ.

(7) *Bugula margaritifera*, n. sp. (Pl. VIII. fig. 4).

Character.—Zoarium 3 to 4 inches high, lax and straggling. Zoœcia very long and narrow, entirely open in front. A very small spinous process at each upper angle. A subglobose, almost sessile avicularium articulated on the outer border of each zoœcium, close to the bottom.

Habitat.—Station 323, lat. 35° 39′ S., long. 50° 47′ W., 1900 fathoms, blue mud. Station 332, lat. 37° 29′ S., long. 27° 31′ W., 2200 fathoms, Globigerina ooze.

A very interesting form, as coming from such an extreme depth. Its structure, as in most of the abyssal forms, is very delicate and transparent, and it is rooted by an infinite number of radical fibres, each attached to a dead Globigerina shell or similar small particle.

At first sight the avicularia appear to be sessile, but they are in reality articulated to the outer edge of the frontal aperture.

§ 8.

(8) *Bugula neritina*, Linné (sp.).[1]

"Remarkable Coralline," Ellis, Coral., p. 35.
Sertularia neritina, Linn., Dell. Chiaje, Esper.
Cellularia neritina, Pallas, Fleming, Johnst., &c.
„ „ Bk., Ann. and Mag. Nat. Hist., ser. 2, vol. vii. pl. viii. figs. 5, 6, 7.
Cellaria neritina, Solander, Lamk., Esper., t. xiii. fig. 123.
Bugula neritina, Oken, Gray (pars), Bk., Brit. Mus. Cat.
Acamarchis neritina, Lamx., Risso, Blainv.
„ „ d'Orb., Ann. des Sci. Nat., 1851, p. 313.

Character.—Zoœcia rhomboidal, elongated, truncate above, with projecting angles. Noavicularia.

Habitat.—Station 36, off Bermudas, 30 fathoms, coral.

[Britain, Scarborough Bean, Falmouth, F. W. Smith; New Zealand, Hooker Lyall, Darwin; Auckland Island, Hooker; Australia, Voy. of Rattles.; Rio de Janeiro, Lyall; North America, Ellis; Bay of Honduras, Shadbolt; Adriatic, Heller; Gulf of Spezzia, Tasmania, Miss Gatty.]

(9) *Bugula longissima*, n. sp. (Pl. XXXI. fig. 7).

Character.—Zoarium of long, straggling, lax growth, very irregularly branched. Zoœcia usually produced downwards into a long tubular portion, a constriction being placed at the junction of the dilated upper portion and the tubular, and a second constriction near the lower end. Aperture oblong, occupying the entire front of the dilated portion; a conical process on the upper and outer angle. Oœcium globose, acuminate, surface engine-turned.

Habitat.—Station 149D, Royal Sound, Kerguelen, 28 fathoms. Station 151, off Heard Island, 75 fathoms, volcanic mud.

Remarkable amongst its congeners, of which it is probably most closely allied to *Bugula* (*Halophila*) *johnstoniæ*, Gray, by the long tubular prolongation of the zoœcium downwards. In fact the appearance of that portion with its constrictions above and below indicates that it is homologous in all probability with a segment of a radical tube; as which, I should be inclined to regard it, in accordance with what has been remarked, more particularly with reference to *Bicellaria macilenta* (p. 35).

[1] Mr. Hincks does not include this species in his list of British Marine Polyzoa; and its occurrence in the two localities cited has probably been accidental.

There is a single, large, oval, interzoœcial disc in the wall between the zoœcia, where they are in apposition.

3. *Kinetoskias*, Koren and Daniellsen.

Bugula, sp., Smitt.
Naresia, Wyv. Thoms.

Character.—Zoarium composed of bifurcating branches radiating from a common centre and forming a wide infundibuliform vase. The lower part of the branches united by a delicate membrane, and the whole supported on a chitinous cylindrical stem, which is rooted by radical *fibrillæ*. Avicularia marginal, shortly pedunculate. At the bottom of each zoœcium a special muscle for bending the zoœcium forwards.

In 1867, D. C. Daniellsen[1] described two new forms of Polyzoa found by him in Nordland and Finmark, which he proposed to refer to a new genus—*Kinetoskias*, from the circumstance that the branches appeared to have some power of motion in curling their extremities outwards. And in the same year, a month or two later, Prof. Smitt,[2] apparently unaware that a new name had been proposed, described one of the forms noticed by Daniellsen, under the name of *Bugula umbella*, procured from Wijde Bay, Spitzbergen.

On the 30th January 1873, on the Challenger Expedition, a specimen of large size, closely allied to, if not identical with one of those described by Koren and Daniellsen was described and figured by Sir C. W. Thomson,[3] under the name of *Naresia cyathus*. This specimen was procured from a depth of 1525 fathoms, in the North Atlantic; and a second specimen of the same form but of smaller size was procured on the 2nd March 1876, in the South Atlantic, from a depth of 2650 fathoms. Other specimens of a closely allied but quite distinct form were obtained on the 10th of September 1875, also in the South Atlantic, from a depth of from 32 to 400 fathoms, and again on the 14th December, in lat. 33° 31′ S., and long. 74° 43′ W., from a depth of 2160 fathoms.

The two original forms, first noticed by M. Daniellsen, have been since more fully described and figured by himself and M. Koren.[4]

We are thus made acquainted with what appear to be four distinct species of this very peculiar type, viz :—

1. *Kinetoskias smittii*, Koren and Daniellsen.

Bugula smittii, Sars.

[1] *Förhandl. Vidensk. Selsk.*, Christiania, 1867, p. 23.
[2] Kritisk. Förteckn. Skandinav. Hafs-Bryozoer, *Öfversigt k. Vetensk.-Akad. Förhandl.*, 1867, pp. 292–353, pl. xix. figs. 28, 31.
[3] *Nature*, vol. i. p. 387.
[4] Fauna littoralis Norvegiæ, part iii., 1877, p. 104, pl. iii. figs. 12–14.

2. *Kinetoskias arborescens*, Daniellsen.
   Kinetoskias arborescens, K. and D.
   Bugula umbella, Smitt.

3. *Kinetoskias cyathus*, Wyv. Thoms. (sp.)
   Naresia cyathus, Wyv. Thoms.
   ? *Kinetoskias smittii*, K. and D.

4. *Kinetoskias pocillum*, Busk.

Of the above, two have come under my observation from the Challenger collection, viz. :—*Kinetoskias cyathus*, Wyv. Thoms., and *Kinetoskias pocillum*, Busk.[1]

(1) *Kinetoskias cyathus*, Wyv. Thoms. (sp.) (Pl. VIII. fig. 1).

Naresia cyathus, Wyv. Thoms., Voyage of the Challenger, The Atlantic, vol. i. p. 142, 1877.

Character.—Zoœcia about 0″·045 by 0″·02; oblong, the outer border somewhat hollowed, and towards the lower part presenting a sort of step on which the avicularium is articulated, and furnished with a special muscle (Pl. VIII. fig. 1*a*). Aperture entire, or very nearly so. The upper and inner angle rounded off, and the external produced into a short pointed conical process. Posteriorly the zoœcium (fig. 1*b*) is very convex, and the surface perfectly smooth. The outline is much the same as in front; the outer border is acute, and the inner rounded. Oœcia of large size, attached to the middle of the summit of the zoœcium in front, and projecting forwards in the form of a wide shallow hood.

Avicularia about 0″·02 long, by 0″·006 wide, the mandible measuring 0″·01, and being much curved.

Habitat.—Station VI., lat. 36° 23′ N., long. 11° 18′ W., 1525 fathoms; Globigerina ooze. Station 325, lat. 36° 44′ S., long. 46° 16′ W., 2650 fathoms; blue mud.

Messrs. Koren and Daniellsen are inclined to consider that their *Kinetoskias smittii* is identical with *Kinetoskias cyathus;* but so far as I am able to judge from their detailed description and figures, this can hardly be the case. The form and size of the zoœcia, and of the avicularia and oœcia, undoubtedly appear to correspond with those of *Kinetoskias cyathus;* but the general aspect of the zoarium in the two cases is utterly dissimilar.

In this particular, however, it should be remarked that the natural size figure given in their pl. iii. does not at all correspond with the description in the text. But in *Kinetoskias cyathus* there are no transverse rugæ on the back of the zoœcium, and the avicularium in *Kinetoskias smittii* is apparently attached above the middle of the outer border, whilst in *Kinetoskias cyathus* it arises from a distinct step-like process very near the bottom.

[1] In the *Quart. Journ. Micr. Sci.*, N. S., vol. xxi. Jan. 1881, I have given an account of the structure of this very remarkable genus, the principal points connected with which had however already been noticed by Messrs. Koren and Daniellsen, and by Professor Smitt, who had left very little new to be said on the subject.

On these grounds there does not appear to be any sufficient reason to regard *Kinetoskias smittii* and *Kinetoskias cyathus* as specifically the same.

(2) *Kinetoskias pocillum*, Busk (Pl. VIII. fig. 2).

Kinetoskias pocillum, Bk., Quart. Journ. Micr. Soc., vol. xxi., N. S., p. 7, pl. i. figs. 2, 5, 1881.

Character.—Zoarium like that of *Kinetoskias cyathus*, but much smaller. Zoœcia rather contracted at the bottom, rounded above, and without any angular process. Avicularium (fig. 2*d*) affixed to the outer border about the middle. Posteriorly convex (fig. 2*b*), quite smooth, outline irregularly oblong, the outer border being sharp and the inner rounded and gibbous. Oœcia smaller than in *Kinetoskias cyathus*, cucullate, the opening looking obliquely outwards and downwards. Avicularia larger and proportionately wider than in *Kinetoskias cyathus*.

Habitat.—Station 122, lat. 9° 5′ to 10′ S., long. 34° 49′ to 53′ W., 32 to 400 fathoms. Station 299, lat. 33° 31′ S., long. 74° 43′ W., 2160 fathoms; blue mud.

As compared with the second species,—*Kinetoskias arborescens*,—described by Koren and Daniellsen,[1] pretty nearly the same amount of difference exists between that form and *Kinetoskias pocillum*, as between *Kinetoskias smittii* and *Kinetoskias cyathus*. At the same time there are one or two points which induce some hesitation in positively asserting that the second Challenger form and *Kinetoskias arborescens* are not the same. The chief points of difference would appear to be:—1st, The position of the avicularium, which in *Kinetoskias arborescens* is placed at the upper and outer angle, whilst in *Kinetoskias pocillum* it is invariably seated at the middle (or a little below it) of the outer border. 2nd, In *Kinetoskias arborescens* the dorsal surface is strongly striated transversely, the ridges being elevated and oblique from below upwards and inwards, &c., whilst in *Kinetoskias pocillum* the dorsal surface is perfectly even and polished.

With respect to the *Bugula umbella* of Prof. Smitt, as from his admirable description and excellent figures there can, I think, be no doubt that it is the same as *Kinetoskias arborescens*, Koren and Daniellsen, what has been said with regard to a comparison between that form and either of those in the Challenger collection, will equally apply to Prof. Smitt's. His specimen, however, seems to have been imperfect, as it has no peduncle, and appears to be turned inside out, and at all events is represented as it would seem the wrong way up in the figure.[2]

Prof. Smitt's description of the mode of commencement of the zoœcial portion[3] corresponds exactly with what I have been able to make out in *Kinetoskias cyathus*, as does also his admirable account of the mode of formation, and true nature of the web-like expansion connecting the zoœcial branches at the bottom of the cup.

[1] *Loc. cit.*, pl. xii. figs. 9–14, and *Förhandl. Vidensk. Selsk.*, Christiania, 1867, p. 27.

[2] *Loc. cit.*, pl. xix. fig. 30.

[3] *Ibid.*, fig. 31.

4. *Ichthyaria*, n. gen.

Character.—Zoarium continuous, branched; branches irregularly dichotomous or forked, biserial, zoœcia facing in one direction; the two series very loosely connected. Zoœcia ventricose rounded, front entirely calcified.

Ichthyaria oculata, n. sp. (Pl. XIII. fig. 7).

Character.—Zoœcia pyriform or pisciform, square at the top, gibbous on the inner side. Surface smooth and polished; on the back an elongated vertical fissure remains membranous. Orifice semicircular, with a nearly straight entire lower lip. A conical process on the upper and outer angle, perforated at the base—a large round pore on the outer side, close below the angle of the mouth, and two on the inner, one above the other.

Habitat.—Station 314, lat. 51° 35′ S., long. 65° 39′ W., 70 fathoms, sand. Station 320, lat. 37° 17′ S., long. 53° 52′ W., 600 fathoms, green sand.

Family VII. Gemellariadæ.

Gemellariadæ (pars), Bk., Voy. of Rattles., vol. i. p. 383, Brit. Mus. Cat., vol. i. p. 33.
Eucratiidæ, Hincks (pars).

Character.—Zoarium submembranaceous, flexible, continuous. Zoœcia opposite, in pairs, unarmed.

With the exception of *Notamia*, the Family as here proposed would include those genera arranged under it in the Brit. Mus. Cat., viz:—

Gemellaria, Savigny.
Didymia, Busk.
Dimetopia, Busk.

To which might perhaps be added:—

Scruparia (pars), Hincks (*nec* Smitt).
Brettia, Dyster.
Huxleya, Dyster.

The Family here contains only the following genera:—

1. *Didymia*, Busk.
   Didymia simplex, Busk.

2. *Dimetopia*, Busk.
   Dimetopia cornuta, Busk.

1. *Didymia*, Busk.

Didymia, Bk., Voy. of Rattles., Brit. Mus. Cat.; Macgilliv., Nat. Hist. Vict., Dec. v. p. 34.

Character.—Zoœcia joined side by side, all facing the same way. At a bifurcation each zoœcium of the primary pair giving off a secondary pair. Frontal area almost entirely membranous. Oœcia on a third intermediate zoœcium at a bifurcation.

Although the zoœcia in *Didymia* are in close apposition, I am unable to perceive that there are any interzoœcial pores between them. The polypide has twelve to fourteen tentacles, and its mouth opens at once into a dilated cavity, without any apparent pharyngeal or œsophageal passage. There is nothing in the form of a so-called funiculus besides the bundle of retractor muscular fibres.

Didymia simplex, Busk.

Didymia simplex, Bk., Brit. Mus. Cat., vol. i. p. 35, pl. xxxix.; Macgilliv., *loc. cit.*, p. 34, pl. xlvi. fig. 6. Wyv. Thoms., Nat. Hist. Rev., vol. v. p. 145.

The only species.

Habitat.—Station 163A, lat. 36° 59′ S., long. 150° 20′ E, off Twofold Bay, 150 fathoms, green mud.

[Bass Strait, 45 fathoms, Voy. of Rattles.; Queenscliff, Portland, Victoria, Maplestone; New Zealand, Hutton.]

2. *Dimetopia*, Busk.

Dimetopia, Bk., Brit. Mus. Cat., vol. i. p. 35; Voy. of Rattles., vol. i. p. 384; Macgilliv., Nat. Hist. Vict., Dec. v. p. 34.

Character.—Zoœcia in pairs, apposed back to back; infundibuliform, with a large orifice; each pair facing in a direction at right angles to that of the next; at a bifurcation each of the separate zoœcia gives off a secondary pair.

Dimetopia cornuta, Busk.

Dimetopia cornuta, Bk., Brit. Mus. Cat., vol. i. p. 35, pl. xxix. figs. 2, 3; Voy. of Rattles.; p. 384, pl. i. figs. 7, 8; Macgilliv., Nat. Hist. Vict., Dec. v. p. 34, pl. xlvi. fig. 5. Wyv. Thoms., *loc. cit.*, p. 146.

Character.—Zoœcia contracted below the middle, orifice oblique, wide above; a strong conical process on each side above, and one or two long projecting spines in front; inserted below the margin.

Habitat.—Station 163A, lat. 36° 59′ S., long. 150° 20′ E., off Twofold Bay, 150 fathoms, green mud (only a small fragment).

[Bass Strait, 45 fathoms, Voy. of Rattles; Queenscliff, Sealer's Cove, Baron v. Müller; Portland, Maplestone.]

Family VIII. Farciminariadæ.

Farciminariadæ, Bk., Brit. Mus. Cat., vol. i. p. 32; (*nec*) Quart. Journ. Micr. Sci., N. S., vol. i. p. 155.

Character.—Zoarium submembranaceous or corneous, continuous, erect, ramose, radicate. Zoœcia quadri- or multiserial, disposed round an imaginary axis, and forming cylindrical or prismatic branches.

1. *Farciminaria*, Busk.

(1) *Farciminaria atlantica*, n. sp. (Pl. XXXI. fig. 6).
(2) *Farciminaria cribraria*, n. sp. (Pl. V. fig. 2).
(3) *Farciminaria magna*, n. sp. (Pl. V. fig. 1).
(4) *Farciminaria brasiliensis*, n. sp. (Pl. XXXI. fig. 2).
(5) *Farciminaria pacifica*, n. sp. (Pl. XXXI. fig. 4).
(6) *Farciminaria gracilis*, n. sp. (Pl. V. fig. 3).
(7) *Farciminaria delicatissima*, n. sp. (Pl. XXXI. fig. 5).
(8) *Farciminaria hexagona*, n. sp. (Pl. XIV. fig. 10, and Pl. XXXI. fig. 3).

1. *Farciminaria*, Busk.

Farciminaria, Bk., Brit. Mus. Cat., vol. i. p. 32; (*nec*) Quart. Journ. Micr. Sci., N. S., vol. i. p. 155; Kirchenpauer (pars)?

Character.—Zoarium furcate or dichotomous; the angle at each bifurcation occupied by a hollow membranous expansion (modified zoœcium?). Zoœcia oblong, elongated, almost entirely membranous in front, which is depressed or flat, with an acute angular border. Avicularia, when present, sessile or subimmersed, placed at the bottom in front. Mouth close to the summit, more or less protruded, the oral valve projecting. Oœcia cucullate, superior.

In the Quart. Journ. Micr. Sci. (*loc. cit.*) I described two forms of a corneous texture, and formed of cylindrical branches constituted of utricular zoœcia, under the generic term *Farciminaria*, following in this, M. Kirchenpauer, to whom I was indebted for the specimens. But I am now satisfied that these two forms cannot be placed in the same genus with my *Farciminaria aculeata*, though belonging, as it seems to me, to the same family. I would therefore venture to propose that the two species in question should, in accordance with my former suggestion, be named *Verrucularia*, v. Suhr, notwithstanding the circumstance that v. Suhr regarded *Verrucularia dichotoma* as a fucus; as which also I believe Dr. Harvey considered *Farciminaria binderi* of Kirchenpauer.

The genus may be regarded emphatically as abyssal; the mean depth at which the species here enumerated occurred, being not less than 1500 to 1600 fathoms, or from 450 to 2750 fathoms.

(1) *Farciminaria atlantica*, n. sp. (Pl. XXXI. fig. 6).

Character.—Zoarium 2 to 3 inches high, arising in a single slender stem from a dense tuft of radical fibres, and dividing into several furcate branches. Zoœcia multiserial, elongate oblong, rounded at the top and slightly prominent; contracted downwards; the sides of the front beset with numerous, simple, incurved, equidistant aculeate spines. A rather large immersed avicularium of an oval form with a semicircular mandible pointing upwards, at the bottom of the front in the middle. Oœcium immersed, surface smooth (not aculeate).

Habitat.—Station 23, off Sombrero Island, 450 fathoms, Pteropod ooze. Station 24, off Culebra Island, 390 fathoms, Pteropod ooze.

Differs from the Australian *Farciminaria aculeata*, Bk., which it otherwise strongly resembles, in the aculeate marginal spines being simple and not furcate, as they mostly are in that species; in the smoothness and comparatively smaller size of the oœcium; and in the presence on very many of the zoœcia of a large avicularium.

(2) *Farciminaria cribraria*, n. sp. (Pl. V. fig. 2).

Character.—Zoarium 3 to 4 inches high. Zoœcia about 0″·05 long; wall reticulate or cribriform. A sessile prominent avicularium at the base of each in front, cup-shaped, with a pointed beak and acute, curved, triangular mandible. Oœcium flattened in front.

Habitat.—Station 323, lat. 35° 39′ S., long. 50° 47′ W., 1900 fathoms, blue mud.

The very peculiar reticulated structure of the walls is a remarkable characteristic of this species.

(3) *Farciminaria magna*, n. sp. (Pl. V. fig. 1).

Character.—Zoarium 5 to 6 inches high; branches very long and straggling. Zoœcia from 0″·055 to 0″·07 long by 0″·015 wide. Walls thin, angles quite sharp, upper border level with the surface. Oœcia large, somewhat flattened, partially immersed, with a vertical depression in the centre of the front; surface slightly wrinkled; with or without avicularia.

Habitat.—Station 153, lat. 65° 42′ S., long. 79° 49′ E., 1675 fathoms, blue mud. Station 325, lat. 36° 44′ S., long 46° 16′ W., 2650 fathoms; blue mud.

In all the specimens from Station 153, there is a minute parasitic Cirriped (?) in the axil of the last bifurcation but one of every branch; apparently a commensal.

Var. α. *armata* (Pl. XXXI. fig. 1).

Character.—Zoarium 4 or 5 inches high, branches long, straggling, once or twice furcate. Zoœcia precisely like those of *Farciminaria magna*, except that, more especially towards the lower part of the branches, they are furnished with an egg-shaped avicularium in the centre at the base and deeply immersed; the opening is quite at the summit, and the mandible appears to form a mere lid, and is rather less than a semicircle.

Habitat.—Station 323, lat. 35° 39′ S., long. 50° 47′ W., 1900 fathoms, blue mud.

(4) *Farciminaria brasiliensis*, n. sp. (Pl. XXXI. fig. 2).

Character.—Zoarium about 2 inches high, with five or six once furcate branches. Zoœcia about 0″·05 × ·0075; frontal area slightly closed in at the bottom; a small, deeply immersed, globular, sessile avicularium, with a semicircular mandible. Oœcia somewhat flattened, not hollowed in front, surface coarsely rugose.

Habitat.—Station 122, lat. 9° 5′ to 10′ S., long. 34° 49′ to 53′ W., 32 to 400 fathoms; red mud.

(5) *Farciminaria pacifica*, n. sp. (Pl. XXXI. fig. 4).

Character.—Zoarium probably large. Zoœcia 0″·06 × ·01; angles thick and rounded, upper border immersed, orifice very slightly prominent. A globose cup-shaped avicularium, with a semicircular mandible placed to one side at the base in front. Oœcium large, convex, surface rugose, with a slight central vertical depression in front, flattened or immersed behind, with a sort of projecting collar; a reniform stigma on the summit.

Habitat.—Station, 241, lat. 35° 41′ N., long. 157° 42′ E., 2300 fathoms, red clay.

The reniform mark on the summit of the oœcium appears to represent the suppressed avicularium of the superjacent zoœcium.

The only specimen in the collection is a fragment about 1 inch long, which constituted the sole contents of a small tube, so that no idea can be formed of the general habit; but it would probably be like that of *Farciminaria cribraria* or *Farciminaria brasiliensis*.

(6) *Farciminaria gracilis*, n. sp. (Pl. V. fig. 3).

Character.—Zoarium 1 to 1½ inches high, branches short, slender, curved, once or twice forked. Zoœcia 0″·05 to ·06 long, slightly narrowing downwards; upper border projecting, lip protruding. A globose, cup-shaped avicularium placed rather to one side, with a triangular obtusely pointed mandible, which is directed obliquely downwards and outwards. Oœcium lofty, constricted below, with an arched lower border forming a blunt process on either side.

Habitat.—Station 70, lat. 38° 25′ N., long. 35° 50′ W., 1675 fathoms, Globigerina ooze. Station 122, lat. 9° 5′ S., long. 34° 50′ W., 32 to 400 fathoms, red mud.

The small size and peculiarly curved, divaricate, slender branches, at once serve to distinguish this species.

(7) *Farciminaria delicatissima*, n. sp. (Pl. XXXI. fig. 5).

Character.—Zoarium from 2 to 3 inches high, composed of once or twice forked straight branches. Zoœcia 0″·10 to ·11 long, much attenuated downwards; upper border subcucullate. Orifice very prominent when open; walls exceedingly delicate and flexible. No avicularia. Oœcium subconical, rounded in front, enveloped above in a prolongation of the epitheca or epidermis; lower border even. A long pouch distinct from the zoœcial cavity in front of each oœcial cell.

Habitat.—Station 13, lat. 21° 38′ N., long. 44° 39′ W., 1900 fathoms, Globigerina ooze. Station 68, lat. 38° 3′ N., long. 39° 19′ W., 2175 fathoms, Globigerina ooze. Station 64, lat. 35° 35′ N., long. 50° 27′ W., red clay. Station 89, lat. 22° 18′ N., long. 22° 2′ W., 2400 fathoms, Globigerina ooze. Station 106, lat. 1° 47′ N., long. 24° 26′ W., 1850 fathoms, Globigerina ooze. Station 14, lat. 21° 1′ N., long. 46° 29′ W., 1950 fathoms, Globigerina ooze.

(8) *Farciminaria hexagona*, n. sp. (Pl. XIV. fig. 10, and Pl. XXXI fig. 3).

Character.—Zoarium 7 to 8 inches high, composed of very long, straggling, straight, or slightly curved branches, twice furcate; sometimes with a broad web uniting the branches at the bottom of a bifurcation. Zoœcia in six series; 0″·04 to ·05 long., narrow; walls very thin and transparent, angles sharp; upper border quite level. Orifice small, prominent, but with a very narrow chitinous border. Oœcia?

Habitat.—Station 145, lat. 46° 43′ S., long. 38° 4′ E., 140 to 310 fathoms. Station 196, lat. 0° 48 S., long. 126° 58′ E., 825 fathoms, hard ground. Station 195, lat. 4° 21′ S., long. 129° 7′ E., 1425 fathoms, blue mud.

In two out of the six series, the zoœcia are narrower than in the others, and apparently always uninhabited, and without any oral orifice.

Group B. FLUSTRINA.

Family IX. Flustridæ.

Flustradæ, Bk., Brit. Mus. Cat., vol. i. p. 46; Gray (pars), Br. Rad., p. 145.
Flustridæ (pars) d'Orb., Rech. s. les Bryoz., Ann. d. Sci. Nat., 1851, p. 314; Hincks, Brit. Mar. Polyz. vol. i. p. 113; Smitt, Krit. Förteck. Skandinav. Hafs-Bryzoer, 1867, p. 357.
Escharidæ (pars), Johnst., Brit. Zooph., 1st ed. p. 248; 2nd ed. p. 263; d'Orb.
Polypiers à réseau (pars), Lamk.
Flustrées, Lamx., Exp. Méth.

Character.—Zoarium membranaceous, expanded and foliaceous, or ligulate; erect (sometimes decurrent on the support), uni- or bi-laminar. Zoœcia quincuncially arranged, more or less open and membranaceous in front, without a raised border; avicularia, when present, usually vicarious.

The Family here contains the following genera:—

§ A. Zoœcia contiguous.

§§ *α. Utrinque porosæ*, Linné.

1. *Flustra*, Linné.
   (1) *Flustra crassa*, n. sp. (Pl. XVI. fig. 6.)
   (2) *Flustra denticulata* Busk (Pl. XXXII. fig. 2).
   (3) *Flustra biseriata*, n. sp. (Pl. XVI. fig. 1).
   (4) *Flustra membraniporides*, n. sp. (Pl. XXXII. fig. 7).

§§ *β. Pagina altera tantum porosæ*, Linné.

2. *Carbasea*, Gray.
   (1) *Carbasea ovoidea*, Busk (Pl. XVI. fig. 3).
   (2) *Carbasea dissimilis*, Busk.
   (3) *Carbasea elegans*, Busk (Pl. XVI. fig. 5).
   (4) *Carbasea pedunculata*, n. sp. (Pl. XVI. fig. 4).
   (5) *Carbasea moseleyi*, n. sp. (Pl. XXXIII. fig. 4).
   (6) *Carbasea pisciformis*, Busk.
   (7) *Carbasea cribriformis*, Busk. (Pl. XXXIV. fig. 8).

§ B. Zoœcia disjunct.

3. *Diachoris*, Busk.
   (1) *Diachoris magellanica*, Busk.
   var. *α distans* (Pl. XVI. fig. 2).

(2) *Diachoris crotali*, Busk.
(3) *Diachoris costata*, Busk (Pl. XXXIV. fig. 4).
(4) *Diachoris inermis*, Busk.
(5) *Diachoris hirtissima*, Heller.

§ A. Zocœcia contiguous.

§§ *a*. *Utrinque porosæ*, Linné.

1. *Flustra*, Linné.

Flustra, Bk., Brit. Mus. Cat., vol. i. p. 47.
„ (sp.) Linn., Auctt; Hincks, Brit. Mar. Polyz., vol. i. p. 114, § *a*.
Eschara (pars), Pallas.

Character.—Zocœcia disposed in two inseparable layers (except when decurrent).

(1) *Flustra crassa*, n. sp. (Pl. XVI. fig. 6).

Character.—Zoarium broadly lobate, very thick and fleshy. Zocœcia elongated, oblong, entirely membranous in front; a short conical point at each upper angle. Oœcium cucullate, erect.

Habitat.—Station 149D, Royal Sound, Kerguelen Island, 28 fathoms, volcanic mud.

Remarkable for its thick, almost fleshy consistence.

(2) *Flustra denticulata*, Busk (Pl. XXXII. fig. 2).

Flustra denticulata, var. *inermis*, Bk., Brit. Mus. Cat., vol. i. p. 49, pl. xlix. figs. 3, 4.

Character.—Zoarium composed of linear branches slightly expanding at the ends. Zocœcia elongated pyriform, with a few very minute internal hooked spicules on each side, more especially towards the lower part. Avicularia rare, small, obliquely quadrangular, with an acute mandible placed obliquely.

Habitat.—Station 163A, lat. 36° 59′ S., long. 150° 20′ E., off Twofold Bay, 150 fathoms, green mud.

[New Zealand, Dr. Lyall.]

The form denominated *Flustra denticulata* in the Brit. Mus. Cat., p. 49, described and figured, as it would seem, in the most fully developed condition (pl. lvii.), is one which presents considerable difficulty with respect to the varieties it exhibits. In the form shown in pl. lvii. (*loc. cit.*), the border of the front is furnished with very remarkable tooth-like, usually bifid spines, which arch over the front, decussating more or

less in the mesial line; and a small upturned spine is seen on each side of the mouth. In the form termed "*inermis*" (*loc. cit.*, pl. xlix. figs. 3, 4) the curious external marginal teeth are entirely absent. In all other respects, however, it agrees with the former, that is to say, in the peculiar form and position of the avicularia, and the habit and general characters of the zoarium. They agree also in the circumstance that the sides of the zoœcium *within* the frontal membrane are furnished with a few distant, minute, sharp-curved spines or spicules, whose function is very obscure.

The Challenger form agrees in all respects with the second variety, except that it presents no vestige of the ascending spine on each upper angle. But on this account alone it cannot perhaps be looked upon as more than a variety.

The marginal zoœcia are for the most part void of polypides; and they are much more slender than the inhabited ones. But whether inhabited or not, these zoœcia always have their external wall furnished with a series of discoid stigmata, probably homologous with interzoœcial pores or "Rosettenplatten," as they are termed, none of which, however, appear to exist in the ordinary oœcia.

(3) *Flustra biseriata*, n. sp. (Pl. XVI. fig. 1).

Character.—Zoarium composed of very narrow, ligulate, bifurcate branches; probably several inches high. Zoœcia biserial, broadly ovate, truncated below, very convex in front. Orifice very wide.

Habitat.—Station 196, lat. 0° 48′ S., long. 126° 58′ E., 825 fathoms, hard ground. Station 299, lat. 33° 31′ S., long. 74° 43′ W., 2160 fathoms, blue mud.

The ligulate divisions or branches are bordered on each side by a continuous chitinous tube.

(4) *Flustra membraniporides*, n. sp. (Pl. XXXII. fig. 7).

Character.—Zoarium composed of narrow, ligulate, forked lobes. Zoœcia pyriform in outline, with a large oval aperture occupying more than half the length. Border slightly raised. A short marginal spine on each side above; one or two sessile avicularia, with short triangular mandible, on the front of the closed portion of the zoœcia near the bottom. In the marginal zoœcia the avicularium is larger and always single. Oœcium small, inconspicuous, with a flattened, triangular or trifid space in front. Surrounded with a raised fascia, which is continued across the lower border.

Habitat.—Station 163B, Port Jackson, 35 fathoms, hard ground. Station 162, off East Moncœur Island, Bass Strait, 38 fathoms, sand, shells.

The zoœcia in this doubtfully-placed form are in all respects of the membraniporidan type, but the zoarium is equally that of a *Flustra*.

The trifid space in front of the zoœcium appears to be of the same nature, whatever that may be, as that of the similarly shaped stigma on the oœcium in so many of the Australian Retepores.

§§ *β. Pagina altera tantum porosæ*, Linné.

2. *Carbasea*, Gray.

Carbasea, Gray, Cat. Brit. Rad., 1848.
„ Bk., Brit. Mus. Cat., p. 50.
Semiflustra, d'Orb.

Character.—Zoœcia in a single layer. Front either completely or partially membranous.

(1) *Carbasea ovoidea*, Busk (Pl. XVI. fig. 3).

Carbasea ovoidea, Bk., Brit. Mus. Cat., p. 52, pl. l. figs. 5, 6, 7.

Character.—Zoarium broadly lobate, margin of lobes notched. Zoœcia pyriform, slightly contracted below. Membranous aperture oval, occupying the upper two-thirds of the front, and filled in by a very convex membrane.

Habitat.—Station 149D, Royal Sound, Kerguelen, 28 fathoms. Station 149H, I, K, off Christmas Harbour 127 to 45 fathoms. Station 149G, London River, 110 fathoms. Marion Island, 50 to 75 fathoms. Station 315, lat. 51° 40′ S., long. 57° 50′ W., 5 to 12 fathoms, sand and gravel. Prince Edward Island, 80 to 150 fathoms. Port William, Falkland Islands, 5 to 10 fathoms. Station 303, lat. 45° 31′ S., long. 78° 9′ W., 1325 fathoms, Globigerina ooze. Station 312, lat. 53° 38′ S., long. 70° 56′ W., 10 to 15 fathoms, mud.

[Strait of Magellan (Moseley); Coast of Patagonia, Darwin; Kerguelen Island, Eaton.]

(2) *Carbasea dissimilis*, Busk.

Carbasea dissimilis, Bk., Brit. Mus. Cat., vol. i. p. 51, pl. xlix. figs. 4–7.
Flustra carbasea, var. *β*, Lamk.

Character.—Zoarium composed of long ligulate branches. Zoœcia pyriform, much attenuated below. Membranous aperture oval. Marginal zoœcia with an acute, short, spinous process at the upper and outer angle. A sessile avicularium below the membranous aperture on each zoœcium.

Habitat.—Station 161, off entrance to Port Philip, 33 fathoms, sand. Station 162, off East Moncœur Island, Bass Strait, 38 fathoms, sand and shells. Station 163A, off Twofold Bay, 150 fathoms. Station 196, lat. 0° 48′ S., long. 126° 58′ E., 825 fathoms, rock.

[Tasmania, Hooker; Australia, Miss E. Gore.]

(3) *Carbasea elegans*, Busk (Pl. XVI. fig. 5).

Carbasea elegans, Bk., Brit. Mus. Cat., vol. i. p. 53, pl. liv. figs. 6, 7, pl. lvi. fig. 3.

Character.—Zoarium composed of narrow ligulate divisions. Zoœcia oblong. Membranous aperture almost the entire front, square at the lower border.

Habitat.—Station 162, off East Moncœur Island, 38 fathoms, sand and shells. Station 314, lat. 51° 35′ S., long. 65° 39′ W., 70 fathoms, sand.

[Tasmania, B. M.]

(4) *Carbasea pedunculata*, n. sp. (Pl. XVI. fig. 4).

Character.—Zoarium composed of ligulate branches, all in one plane, dividing dichotomously and of uniform width (about 0·125″). Zoœcia broadly ovate, but irregular in size and shape. Branches bordered on each side by a continuous chitinous tube, and the two tubes are continued into a peduncle about 0″·5 to ·75 long, terminating in a tuft of capillary fibres.

Habitat.—Station 75, lat. 38° 38′ N., long. 28° 28′ W., 450 fathoms, volcanic mud. Station 76, lat. 38° 11′ N., long. 27° 9′ W., 900 fathoms, Globigerina ooze.

The single specimen of this species included in the collection is unfortunately in a very imperfect condition—torn and ragged—so that the full dimensions of the growth cannot be determined from it. The zoœcia are amongst the largest with which I am acquainted, about 0″·05 × ·035; and the zoarium, like that of most of the very deep water forms, is extremely flaccid and tender.

(5) *Carbasea moseleyi*, n. sp. (Pl. XXXIII. fig. 4).

Character.—Zoarium about 0″·75 high, narrow, fan-shaped, and apparently shortly pedunculate; bordered on each side by a continuous chitinous tube. The growing edge serrated. Zoœcia hexagonal, 0″·04 × ·035, very convex in front, flatter behind; wall very transparent, but entirely calcified. A series of six apparent punctures on each side in the upper half of the front only, the series being continued across the top above the mouth. Besides these, a variable number (8 to 10) of rather smaller punctures towards the upper part of the front. On some of the zoœcia a large horse-shoe-shaped mark is seen in the lower part of the front, apparently representing a cavity in or just within the anterior wall. Orifice large, crescentic, with a very strong chitinous lip.

Habitat.—Station 170, off Kermadec Islands, 520 fathoms, volcanic mud.

This very remarkable and extremely beautiful species is represented by only a single specimen, for which I am indebted to Mr. Moseley, who had mounted it while quite recent

and apparently alive in Canada balsam, having previously stained the tissues with carmine. All the details of its anatomy, consequently, are beautifully displayed. The polypide has about twenty-four tentacles, a rather wide œsophagus, and a simple saccular stomach, without any *diverticulum*, and the rectum opens very low down into the tentacular sheath. The retractor muscles consist of long, slender, non-striated fibres each of which presents a single nucleus at some part of its length (fig. 4*d*). Besides the muscular fibres, there is no appearance of a so-called *funiculus*.

The peculiar horse-shoe-shaped mark visible in a few of the zoœcia appears to represent a flattened cavity on the inner face of the anterior wall, and probably lying between the ectocyst and endocyst, if the calcareous wall be taken to represent the former. In the older zoœcia this cavity is quite empty and clear, but in one or two of the marginal, immature zoœcia, in which the polypide is still represented merely by an elongated mass of granular matter (fig. 4*b*), the faintly seen but distinct horse-shoe-shaped organ appears to contain a collection of extremely minute granules. There is no direct indication whatever that these organs are of an ovarian or testicular character, and in the whole zoarium I have been able to perceive their existence in not more than about six or seven cells.

The lateral and central apparent puncta in the anterior wall have all the characters of the ordinary form of interzoœcial pores or discs ("Rosettenplatten"), and like those structures may be described as perforations in the calcified wall or ectocyst, filled in, however, by a delicate membrane, or rather double membrane, between whose layers are lodged eight to ten minute spherical granules, deeply coloured with the carmine (fig. 4*c*). The outer layer is in this case formed apparently by a very delicate epitheca, and the inner by the equally delicate endocyst.

In several of the zoœcia the polypides appear to have been killed so suddenly that they have not had time to retract themselves wholly into the cell, so that the extremities of the tentacles have been caught by the sudden closure of the operculum.

(6) *Carbasea pisciformis*, Busk.

Carbasea pisciformis, Bk., Brit. Mus. Cat., vol. i. p. 50, pl. lv. figs. 1, 2; pl. lvi. fig. 6; Macgilliv., Nat. Hist. Vict., Dec. v. p. 30, pl. xlv. fig. 6.

Character.—Zoarium broadly lobate, lobes rounded, entire at the margin. Zoœcia elongated, pyriform, truncated at both ends, and much contracted near the bottom, which is again slightly expanded. Oœcia immersed, marked with radiating lines.

Habitat.—Station 162, off East Moncœur Island, Bass Strait, 38 fathoms, sand, shells.

[Tasmania, Brit. Mus. Collect.; Queenscliff, Portland, Victoria, Maplestone.]

The polypide has about twenty-four tentacles, and the stomach a long diverticulum. The retractor muscular fibres are very numerous and slender, and neither nucleated nor

striated. In many of the zoœcia, at some distance from the growing edge, but in which the polypide is still quite vigorous, a narrow linear band may be seen on either side within the perigastric cavity, and anterior to the polypide. These bands are formed by a flexuose tube, cæcal at both ends, and having thick walls lined with an hexagonal epithelium. These organs may be probably either ovarian or testicular, but I have failed to perceive anything within them beyond the epithelium. Whatever their nature may really be, they are perhaps homologous with the peculiar horse-shoe-shaped organ in *Carbasea moseleyi*. They are certainly not parasitic vermicules, although, curiously enough, the latter do sometimes occcur in the interior of a zoœcium in this species.

(7) *Carbasea cribriformis*, Busk (Pl. XXXIV. fig. 8).

Carbasea cribriformis, Bk., Brit. Mus. Cat., vol. i. p. 51, pl. lxviii. fig. 1 ; Haswell, Proc. Linn. Soc. N. S. Wales, p. 37.
Retepora cornea, Bk., Voy. of Rattles., vol. i. p. 380.

Character.—Zoarium composed of circular fenestrated fronds, superimposed one upon the other, and growing spirally from a common centre, one from the other. Zoœcia oval, open in front but with a narrow thickened band all round, within the border ; behind they are convex, and faintly wrinkled or striated transversely with faint longitudinal cicatriciform marks extending the length of the zoœcium. Oœcia globose, completely immersed in the superjacent zoœcium. A wide, thin-walled, flexible, radical tube, springs from an aborted zoœcium at the lower angle of each fenestra.

Habitat.—Station 186, Cape York, 8 fathoms, coral mud. Station 188, lat. 9° 59′ S., long. 139° 42′ E., 28 fathoms, green mud. Station 190, lat. 8° 56′ S., long. 136° 5′ E., 45 fathoms, green mud.

[Off Cumberland Island, Voy. of Rattles.]

The peculiar fenestrate zoarium of this very curious form is at once sufficient for its distinction ; the mere external aspect, except as regards the horny consistence, is exactly that of a Retepore. Whether it should be included among the Flustridæ or should not rather be regarded as a quasi-erect Membraniporidan is extremely doubtful. The zoœcia have a membraniporidan character. The way in which the superimposed fronds or lobes spring in a sort of spiral manner from the centre, sometimes to the number of six or more, is very remarkable ; but besides this central or initial attachment, the fronds are also loosely interconnected by the wide radical tubes springing from the lower angle of each fenestra. A condition which is also more or less membraniporidan.

Mr. Haswell (*loc. cit.*) well describes the very peculiar mode of growth in this species.

§ B. Zoœcia disjunct.

3. *Diachoris* Busk.

Diachoris, Bk., Voy. of Rattles., vol. i. p. 382; Brit. Mus. Cat., vol. i. p. 53; Heller; Macgilliv.; Hutton; &c.
Mollia (pars), Smitt.
Eschara (pars), Moll.

Character.—Zoarium flexuose, spreading, loosely adnate, or suberect and free. Zoœcia flustrine, completely disjunct, each connected with six or more by tubular processes.

(1) *Diachoris magellanica*, Busk.

Diachoris magellanica, Bk., Brit. Mus. Cat., vol. i. p. 54, pl. lxvii.; Macgilliv., *loc. cit.*, p. 32, pl. xlvi fig. 2; Hutton.
Diachoris buskei, Heller, Adriat., p. 93.

Character.—Zoœcia suberect, quite open in front. Orifice circular, with a thickened annular peristome. A pedunculate, articulated, capitate avicularium seated on the margin of the aperture near the top on each side.

Habitat.—Port Jackson, 2 to 10 fathoms. Station 315, lat. 51° 40′ S., long. 57° 50′ W., 5 to 12 fathoms, sand and gravel.

[Portland, Victoria, Maplestone; New Zealand, Hutton; Lyall; Strait of Magellan, Darwin; Adriatic, Heller; Kerguelen, Eaton.]

Var. α *distans* (Pl. XVI. fig. 2).

Zoœcia widely distant.

Habitat.—Station 151, Heard Island, 75 fathoms, volcanic mud (only a small fragment).[1]

(2) *Diachoris crotali*, Busk.

Diachoris crotali, Bk., Brit. Mus. Cat., vol. i. p. 54, pl. lxvi. figs. 1, 2; Voy. of Rattles., vol. i. p. 382, pl. i. figs. 10–12; Macgilliv., Nat. Hist. Vict., Dec. v. p. 32.

Character.—Zoœcia suberect, entirely open in front, with straight sides; three or four punctures on each side and behind; a conical avicularium with a very broad semicircular mandible articulated at each upper angle. Oœcium small, conical above the upper border.

Habitat.—Station 162, off East Moncœur Island, Bass Strait, 38 fathoms, sand, shells.

[Portland? Victoria, Macgillivray; Bass Strait, Voy. of Rattles.]

[1] Mr. Hincks (*Ann. and Mag. Nat. Hist.*, ser. 5, vol. viii. p. 73, pl. v. figs. 4, 5, 1881), describes a species of *Diachoris* under the name of *Diachoris distans*, from South Africa, which, however, appears to be quite distinct from the above.

The zoarium, though spreading in a lobate manner over other foliaceous Polyzoa, does not appear to have any real attachment to them. In the description given in Brit. Mus. Cat. it is stated that there is no movable mandible in the curiously formed oral appendages, but in reality these organs consist of a hollow conical membranous bag, whose base looks forwards and downwards, and is closed by a semicircular membranous lid, which clearly represents the mandible of an avicularium. When collapsed, these appendages assume the figure represented in Brit. Mus. Cat.

(3) *Diachoris costata*, Busk (Pl. XXXIV. fig. 4).

Diachoris costata, Bk., Kerguelen Island Polyz., p. 3, pl. x. figs. 5, 6.

Character.—Zoarium very loosely attached, and spreading irregularly. Zoœcia decumbent in straight rows radiating from central points; elongate fusiform, front entirely covered with numerous ribs, sometimes forked at the end, and interdigitating in the mesial line. Orifice semicircular, lower lip straight, entire; four unarticulated oral spines, two above and one on each side. An articulated, capitate avicularium on one side a short distance from the top; the beak much curved and projecting beyond the acute crooked mandible.

Habitat.—Station 315, lat. 51° 40′ S., long. 57° 50′ W., 5 to 12 fathoms, sand and gravel.

[Queenscliff, Victoria, Wilson; Royal Sound, Kerguelen, Eaton.]

(4) *Diachoris inermis*, Busk.

Diachoris inermis, Bk., Brit. Mus. Cat., vol. i. p. 54, pl. lxxii.; Hutton.

Character.—Zoœcia decumbent, boat-shaped, entirely open in front. Two short marginal spines on each side above and a variable number of small incurved spicules on each side of the orifice. No avicularia.

Habitat—Station 149D, Royal Sound, Kerguelen, 20 to 60 fathoms.

[New Zealand, Dr. Lyall; Strait of Magellan, Darwin.]

In the Brit. Mus. Cat. no mention is made of the fine lateral spicules, but as in all other respects the form there intended is identical with the present, this difference cannot be regarded as of any consequence.

(5) *Diachoris hirtissima*, Heller

Diachoris hirtissima, Heller, Adriat., p. 94, pl. i. figs. 6, 7.
Chaunosia hirtissima, Bk., Quart. Journ. Micr. Sci., vol. vii. pl. xxxvi. figs. 12–16.

Character.—Zoœcia elongated oval; suberect, very convex behind. Orifice semicircular, with a thin prominent peristome above. The entire surface and borders in front and behind beset with longer or shorter pointed spines. Avicularia 0.

Habitat.—Station 352A, off St. Vincent, Cape Verde Islands, 10 fathoms.

[Adriatic, Heller.]

Family X. Membraniporidæ.

Celleporidæ (pars), Johnst.
Membraniporidæ (pars), Brit. Mus. Cat., Smitt, Hincks, &c.
Flustrellidæ, *Flustrinidæ*, *Electrinidæ*, *Escharidæ*, &c. (pars), d'Orb.
Biflustridæ (sp.), Bk., Smitt.
Flustradæ (pars), Gray.
Flustra (pars), Linn.
Microporidæ (sp.), Smitt, Hincks.

Character.—Zoarium membranous, membranaceo-calcareous or calcareous, encrusting and adnate, or erect and free, foliaceous or lobed then bilaminar or polygono-cylindrical. Zoœcia depressed in front with a raised border, the area filled in by a chitinous membrane, beneath which may be an entire or partial, calcified lamina.

The numerous and heterogeneous forms which might be arranged more or less artificially under the above definition may be conveniently, and to some extent perhaps naturally, subdivided into five principal types, which may be regarded, at any rate provisionally, as generic, four of which only, however, are represented in the Challenger collection. The fifth, for which I should propose to adopt M. d'Orbigny's[1] appellation *Pyripora*, would include the forms represented by *Hippothoa* (*Membranipora*) *catenularia* of authors.

The following genera are contained in the Challenger collection :—

1. *Membranipora*, Blainville.

§ *a. simplices* (no marginal spines).

(1) *Membranipora albida*, Hincks (Pl. XV. fig. 4).

(2) *Membranipora crassimarginata* (Hincks).

Var. *a. erecta* (Pl. XIV. fig. 3).

Var. *b. incrustans* (Pl. XV. fig. 5).

[1] Palæont. Franç., p. 538.

§ β. *spinosæ.*

(3) *Membranipora spinosa*, d'Orbigny.

(4) *Membranipora galeata*, Busk.

2. *Amphiblestrum*, Gray.

(1) *Amphiblestrum imbricatum*, n. sp. (Pl. XV. fig. 3).

(2) *Amphiblestrum cristatum*, n. sp. (Pl. XV. fig. 1).

(3) *Amphiblestrum papillatum*, n. sp. (Pl. XXXIII. fig. 1).

(4) *Amphiblestrum cervicorne*, Busk.

(5) *Amphiblestrum umbonatum*, Busk.

(6) *Amphiblestrum capense*, n. sp. (Pl. XXIII. fig. 3).

3. *Biflustra*, d'Orbigny.

Biflustra savartii (Audouin) (Pl. XIV. fig. 2).

4. *Foveolaria*, n. gen.

(1) *Foveolaria elliptica*, n. sp. (Pl. XXIII. fig. 5).

(2) *Foveolaria orbicularis*, n. sp (Pl. XXIII. fig. 4).

(3) *Foveolaria tubigera*, n. sp. (Pl. XIV. fig. 4).

(4) *Foveolaria falcifera*, n. sp. (Pl. XV. fig. 6).

1. *Membranipora*, Blainville.

Membranipora (pars), Blainv., Johnst., Auctt.
Eschara (pars), Pallas.
Flustra (pars), Linn., Lamk., Lamx., &c.
Discopora (pars), Lamk.
Annulipora, *Conopeum*, *Cellepora*, *Amphiblestrum* (sp.), Gray.
Cellipora (pars), d'Orb., Hag., &c.
Marginaria, Roemer.

Character.—Zoarium encrusting, adnate, calcareous or subcalcareous; zoœcia quincuncially or serially disposed in transverse rows or irregularly; no internal calcareous lamina. Operculum incomplete.[1]

The genus *Membranipora*, even as here restricted, includes so many species that it becomes advisable to subdivide it into sections. I am acquainted, either actually or by published descriptions, with between thirty and forty living species, to which no doubt copious additions remain to be made. I have thought it would be convenient, therefore, to arrange them in two sections with nearly equal numbers in each, and distinguished respectively by the artificial character of having or not having marginal spines.

[1] The term *incomplete* is applied to an operculum whose lower border is membranous and more or less ill defined.

§ *a. simplices.*

(1) *Membranipora albida* (?), Hincks (Pl. XV. fig. 4).

(?) *Membranipora albida*, Hincks, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 81, pl. x. fig. 5, 1880.

Character.—Zoarium very delicate, lace-like, closely adnate (on a *Cellepora*). Front oval, border thin, beaded or subcrenate. Avicularia adventitious, placed at the bottom of the front of a zoœcium, oblique, with a much raised beak. Oœcia small, cucullate, surface finely granular.

Habitat.—Station 172, Off Nukalofa, Tongatabu, 18 to 20 fathoms, coral mud. Station 75, lat. 38° 37′ N., long. 28° 30′ W., 450 fathoms, volcanic mud.

[Singapore, on *Tubipora musica*, Hincks.]

The very close resemblance of this form to that described by Mr. Hincks leaves little room for doubt as to their identity; the chief point of difference appears to be the larger size of the avicularia in Mr. Hincks' form.

(2) *Membranipora crassimarginata*, Hincks (sp.).

Var. *a. erecta* (Pl. XIV. fig. 3).

Character.—Zoarium foliaceous, expanded. Zoœcia quincuncial or irregularly serial, contiguous or discrete. Front regularly oval, entirely membranous. Margin rounded, granular. Avicularia vicarious; smaller than the zoœcia, with a large broadly spatulate mandible pointing directly upwards. Oœcia?

Habitat.—Station 162, off East Moncœur Island, Bass Strait, 38 to 85 fathoms, sand, shells. Station 151, Off Heard Island, 75 fathoms, volcanic mud.

Var. *b. incrustans* (Pl. XV. fig. 5).

Membranipora crassimarginata, Hincks, Ann. and Mag. Nat. Hist., ser. 5, vol. vi. p. 71, pl. ix. fig. 1.

(?) *Biflustra lacroixii*, Smitt, Florid. Bryoz., pt. ii. p. 18, pl. iv. figs. 85–88.

Character.—Zoarium adnate (upon shell). Avicularia usually of equal size with the zoœcia. Border sometimes thicker.

Habitat.—Station 135c, off Nightingale Island, Tristan da Cunha, 110 to 150 fathoms.

[Madeira—J. Y. J. *teste*, Hincks; Gulf of Florida—Pourtalès, 13 to 60 fathoms.]

The only difference between the form here described and that noticed by Mr. Hincks in Mr. J. Y. Johnson's collection from Madeira, consists in the apparently more robust or coarser structure of the latter. In the Challenger specimens (very few, however, in

number) the border can in none be said to be crenate, nor is it specially entitled to be called "thick," seeing that it is by no means thicker than in many other allied forms. In the figures here given, however, it should be remarked that the border is not shown quite as thick as it sometimes is. In Prof. Smitt's figures it is also shown as very thin.

§ β. *spinosæ.*

(3) *Membranipora spinosa*, d'Orbigny.

Membranipora spinosa, d'Orbigny, Voy. en Amér. Mérid., pl. viii. fig. 1.
„ *ciliata*, Macgilliv., Nat. Hist. Vict. Dec. iii. p. 30, pl. xxv. fig. 3.

Character.—Zoarium encrusting; zoœcial areas distant, very regularly oval; eight incumbent marginal spines.

Habitat.—Station 163A, off Twofold Bay, 150 fathoms, green mud.

[South Patagonia, d'Orbigny; Australia, Macgillivray.]

(4) *Membranipora galeata*, Busk.

Membranipora galeata, Bk., Brit. Mus. Cat., vol. i. p. 62, pl. lxv. fig. 5.

Character.—Orifice oval; margin thin, membranaceous. Two straight, articulated, tapering, hollow spines, open at the point on each side above. Oœcium cucullate, grooved above the border in front, and crowned with an avicularium with an elongate, spear-shaped mandible pointing directly forwards. A long pedunculate, trumpet-shaped, avicularium rises from the front below the aperture.

Habitat.—Station 149D, Royal Sound, Kerguelen Island, 28 fathoms, volcanic mud.

The peculiar elongated avicularium on the summit of the oœcium is sometimes replaced by one of the trumpet form; in either case this avicularium properly belongs to the superior zoœcium.

Var. *a. furcata.*

The lower pair of spines furcate and the anterior avicularium often wanting, sometimes sessile and of large size, with a small horn on either side.

Habitat.—Off Marion Island, 50 to 75 fathoms. Station 150, lat. 52° 4′ S., long. 71° 22′ E., 150 fathoms, coarse gravel. (On *Onchopora sinclairii, Salicornaria*, sp.)

Var. *b. multifida.*

Lower pair of marginal spines multifid.

Habitat.—Simon's Bay, Cape of Good Hope. Station 75, lat. 38° 38′ N., long. 28° 28′ W., 450 fathoms, volcanic mud. (On the test of an Ascidian.)

Var. *c. erecta.*

Habitat.—Station 320, lat. 37° 17′ S., long. 53° 52′ W., 600 fathoms, green sand. (On a species of *Salicornaria.*)

2. *Amphiblestrum*, Gray.

Membranipora (pars), Auctt. (type, *Membranipora flemingii*).

Character.—A partial internal calcareous lamina. Aperture often more or less trifoliate, or obovate.

(1) *Amphiblestrum imbricatum*, n. sp. (Pl. XV. fig. 3).

Character.—Zoarium incrusting, very closely adnate (on an *Eschara*). Zoœcia, outline arched above, contracted inferiorly. Border thick and tumid, so that the area is very small and almost entirely occupied by a very thick lamina, from the lower part of which springs a strong, calcareous, hatchet-shaped process, on one edge of which is an avicularium, with a slender acute mandible pointing upwards. Oœcia inapparent.

Habitat.—Simon's Bay, Cape of Good Hope.

The zoœcia are disposed very regularly in quincuncial order, and imbricated like fishes' scales or rounded tiles. But the great peculiarity is the curious avicularian process in front of the zoœcia, which is thus almost wholly concealed. *N.B.*—In the figure the border of the front is shown much too thin.

(2) *Amphiblestrum cristatum*, n. sp. (Pl. XV. fig. 1).

Character.—Zoarium of a dark brown colour, thick. Zoœcia in the older portions quite immersed. Area pyriform, much expanded above and contracted below. Margin much raised, acute, smooth. Orifice suborbicular, occupying the upper half of the area; lamina obscurely granular. Two very stout articulated spines close together on each side above. On the sterile zoœcia a small, usually aborted avicularium at the summit. Oœcia large, galeriform, with a strongly marked visor-like crescentic space in front, and at the summit a large avicularium, sometimes sessile, sometimes elevated on a long trumpet-shaped peduncle; mandible obtusely lanceolate, pointing directly forwards. Occasionally a long trumpet-shaped pedunculate avicularium springs from the front of the zoœcium below the aperture.

Habitat.—Station 149D, Royal Sound, Kerguelen Island, 28 fathoms, volcanic mud.

This is one of the most remarkable forms among the Challenger Membraniporidæ. The resemblance of the zoœcium, with its crest and visor-like conformation in front to a

crested helmet is very striking. In the fertile zoœcia both the marginal spines or their basal joints persist in front of the oœcium.

(3) *Amphiblestrum papillatum*, n. sp. (Pl. XXXIII. fig. 1).

Character.—Zoarium very delicate and thin, closely adherent to shell. Zoœcia more or less disjunct, leaving angular spaces. Area in the younger zoœcia oval, in the older irregularly pyriform. Orifice ovate, occupying about half the area. Surface of lamina finely granular. Small avicularia having a triangular mandible on small papillary eminences seated in the angular interzoœcial spaces.

Habitat.—Station 208, lat. 11° 37′ N., long. 123° 31′ E., 18 fathoms, blue mud.

(4) *Amphiblestrum cervicorne*, Busk.

Membranipora cervicornis, Bk., Brit. Mus. Cat., vol. i. p. 60, pl. c. fig. 3, Macgilliv., Nat. Hist. Vict., Dec. iii. p. 32, pl. xxv. fig. 8.

Character.—Frontal area oblong or oval; a strong, much projecting process arising at each upper angle, branching like a stag's horn and bending over the front, usually meeting and sometimes inosculating; several other simple or forked, marginal spines. Oœcia galeriform, crowned with a small avicularium.

Habitat.—Station 162, off East Moncœur Island, Bass Strait, 38 fathoms, sand and shells.

[Williamstown, Victoria, Macgillivray.]

(5) *Amphiblestrum umbonatum*, Busk.

Membranipora umbonata, Bk., Brit. Mus. Cat., p. 57, pl. lxxiii. figs. 6, 7; Macgilliv., Nat. Hist. Vict., Dec. iii. p. 31, pl. xxv. fig. 6.

Character.—Area broadly elliptical; border low; a jointed spine on each side of the mouth. A projecting rostriform avicularium on the front below the aperture. Oœcia globose, prominent, surface brilliant, with a triangular mark in front.

Habitat.—Station 163A, off Twofold Bay, 150 fathoms, green mud (on *Fucus*). Station 313, lat. 52° 20′ S., long. 67° 39′ W., 55 fathoms, sand.

[Tasmania, Mrs. Smith; Australia, Macgillivray.]

The oœcium, as it rises in front of the superjacent cell, raises with itself the avicularium, with which, consequently, it then appears to be surmounted.

(6) *Amphiblestrum capense*, n. sp. (Pl. XXIII. fig. 3).

Character.—Zoarium erect, composed of short, usually furcate, spreading, cylindrical, or subcompressed branches. Zoœcia disposed more or less quincuncially, or in subalternate longitudinal rows on all sides. Frontal areas as wide as long, arched above, slightly contracted below. Border very thick, continuous with the partial lamina below. Aperture obovate or circular, entirely occupied by the operculum, which is obovate, with the occlusor muscles attached about the middle on each side (fig. 1).

Habitat.—Simon's Bay, Cape of Good Hope.

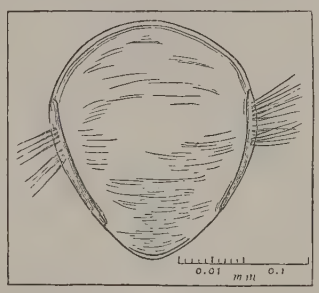


Fig. 1.—*Amphiblestrum capense.*

A small upward spine is articulated on each side above, beyond the border (often wanting or readily detached). The species is very doubtfully placed with *Amphiblestrum*.

3. *Biflustra*, d'Orbigny.

Biflustra, d'Orb., Rech. sur. les Moll. Bryoz. Ann. d. Sci. Nat., sér. 3, t. xviii. p. 330; Palæont. Franç., p. 241; Bk., Crag Polyz., p. 71; Manzoni, Stoliczka, Macgilliv. (sp.), Smitt (pars).
Flustrellaria (pars), d'Orb.

Character.—Zoarium dimorphous, encrusting or decurrent and unilaminar, or foliaceous, erect and bilaminar, readily fissile in all directions. Zoœcia in alternate series, longitudinal or transverse.[1] Zoœcia flustrine, quadrangular or hexagonal (?), with a denticulate lamina at bottom.

Biflustra savartii, Audouin (sp.) (Pl. XIV. fig. 2).

Flustra savartii, Audouin, Egypte, pl. x. fig. 10.
Membranipora savartii, d'Orb., Palæont. Franç., p. 542; Bk., Crag Polyz., p. 31, pl. ii. fig. 6.
,, *corrugata*, Blainv., Dict. d. Sci. Nat., vol. lx. p. 412.
Biflustra savartii, Smitt, Florid. Bryoz., part ii. p. 20, pl. iv. figs. 92–95.

Character.—Zoarium dimorphous, at first decurrent, afterwards rising into a bilaminar expansion. Zoœcial area arched above, with straight sides, and slightly contracted below. Border thick, granular. Aperture oval, lamina finely granular.

Habitat.—Samboangan, Philippine Islands, 10 fathoms.

There may be some doubt whether this is really the *Flustra savartii* of Savigny and of the Crag, but it is very like it, and almost certainly identical with Prof. Smitt's species.

With respect to the true limits of *Biflustra*, regarded as a generic group distinct from Membranipora, opinions may very fairly differ widely.

[1] As in *Biflustra clathrata*, Reuss, which may, however, belong to *Melicerita*.

4. *Foveolaria*, n. gen.

Character.—Zoarium erect, branched and cylindrical, or foliaceous and bilaminar. Front of zoœcia with a thick granular border very deeply imbedded in a pit formed by the thickening of the general ectocyst. A sessile avicularium immediately below or in front of the lower border of the pit.

(1) *Foveolaria elliptica*, n. sp. (Pl. XXIII. fig. 5).

Character.—Zoarium slender, composed of cylindrical forked branches. Front of zoœcia oval or broadly elliptical, border very wide, oral valve occupying rather more than the upper half of the membranous front. Oœcia large, prominent, subglobose, obscurely punctate. Avicularium horizontal, the mandible pointing obliquely to one side.

Habitat.—Station 162, off East Moncœur Island, Bass Strait, 38 fathoms, sand and shells. Station 320, lat. 37° 17′ S., long. 53° 52′ W., 600 fathoms, green sand.

(2) *Foveolaria orbicularis*, n. sp. (Pl. XXIII. fig. 4).

Character.—Zoarium irregularly branched, branches cylindrical, sometimes inosculating, and very irregular in thickness and direction. Zoœcia short. Front orbicular, border rounded, granular; a partial internal lamina, in which is a central elliptical transverse aperture. Median avicularium of small size, with a triangular mandible pointing in various directions.

Habitat.—Station 147, lat. 46° 16′ S., long. 48° 27′ E., 1600 fathoms, Diatom ooze.

In this species, as in *Myriozoum truncatum*, the openings of the zoœcia remain patent only at the very extremities of the branches; elsewhere they are completely obliterated, the only openings seen on the almost uniformly smooth surface of the branches being those belonging to the avicularia, which would appear to be left functionally efficient long after the obliteration of the zoœcia themselves.

(3) *Foveolaria tubigera*, n. sp. (Pl. XIV. fig. 4).

Character.—Zoarium foliaceous, biflustridan in aspect. Zoœcia completely immersed, entirely membranous in front, with a rather thin granular border, broadly oval, slightly constricted about one-third down. General surface entire, smooth. Median avicularium prominent, with an acute mandible or pointed beak, directed horizontally to one side.

Besides this a small avicularium on each side towards the upper part of the front, with a triangular mandible looking directly upwards. On one side of the opening, about one-third from the top, a short wide trumpet-shaped hollow articulated process, closed with a circular chitinous lid. Oœcia subglobose, prominent, but at the same time deeply immersed.

Habitat.—Simon's Bay, Cape of Good Hope.

The curious trumpet-shaped organ on one side only of the opening may probably be a form of avicularium.

I have found it difficult to decide upon the proper place for this form, though it undoubtedly comes within the membraniporidan type. It is placed with the two preceding and the next species, owing to the deep and early immersion of the front of the zoœcium and the presence of the median marginal avicularium.

(4) *Foveolaria falcifera*, n. sp. (Pl. XV. fig. 6).

Character.—Zoarium adnate. Zoœcia completely immersed, so that the general surface appears perfectly even with the openings of the sharply defined pits, at the bottom of which the real front of the zoœcium is placed. The primary area or front, surrounded with a thin granular border, is seen with great difficulty; it is broadly oval, truncated at the bottom, where there is an immersed avicularium, and it is entirely membranous. The secondary opening is elongated and unequally trifoliate or coarctate, but the constriction is greater on one side than the other, and the whole opening becomes oblique and irregularly hour-glass-shaped, much wider below than above; as the ectocyst becomes thickened to form the secondary orifice, the median avicularium increases in size, eventually equalling in length the entire width of the lower border of the opening, across which it lies horizontally, with a strong curved falciform mandible. Behind, the zoœcia are convex, suboval, or pyriform, with a thin diaphanous wall, upon which is a verrucose projection towards the lower part.

Habitat.—Station 320, lat. 37° 17′ S., long. 53° 52′ W., 600 fathoms, green sand.

The avicularium in this case is one of the most extraordinary among the multiform varieties of that organ.

Only a single specimen of the species occurs in the collection, which is adnate upon a *Myriozoum*, and at first sight might be taken for a cylindrical zoarium; and it is not improbable that it is dimorphous, and will be met with perhaps in the biflustran form as well as in the hemescharine. It does not appear to be actually attached to its support though completely sheathing it.

Family XI. Microporidæ.

Microporidæ (pars), Smitt, Hincks.
Membraniporidæ (pars), Auctt.

Character.—The much depressed front of the zoœcia beneath the chitinous epitheca wholly occupied, except at the summit, by a strong calcareous lamina, usually perforated or fissured on the sides, and sometimes forming a transverse diaphragm, which divides the cavity of the zoœcium into two chambers.

Besides the genera classed in the Family as thus defined, I should place in it *Diplopora*, Macgillivray, and *Setosella*, Hincks.

The Family here contains the following genera :—

1. *Micropora*, Gray.
   (1) *Micropora uncifera*, n. sp. (Pl. XV. fig. 7).
   (2) *Micropora coriacea* (Esper).

2. *Vincularia*, Defrance.
   (1) *Vincularia gothica*, d'Orbigny (Pl. XXIII. fig. 1).
   (2) *Vincularia gothica*, var. *granulata*, nov.
   (3) *Vincularia labiata*, n. sp.

3. *Steganoporella*, Smitt.
   Steganoporella magnilabris (Busk) (Pl. XXIII. fig. 2).

4. *Caleschara*, Macgillivray.
   Caleschara denticulata, var. *tenuis*, nov. (Pl. XXI. fig. 9).

1. *Micropora*, Gray.

Flustra (pars), Johnst., &c.
Discopora (pars), Lamk.
Micropora, Gray.
Membranipora (pars), Brit. Mus. Cat.
Lepralia (sp.), Norman.
Steganoporella (sp.), Hincks.
Reptescharellina (pars), d'Orb.

Character.—Zoarium incrusting. Zoœcia with an internal calcareous lamina occupying the entire area, with a perforation at each upper angle below the orifice, which is apical, with a continuous calcareous peristome.

(1) *Micropora uncifera*, n. sp. (Pl. XV. fig. 7).

Character.—Zoarium closely adnate (on *Eschara* and *Fucus*). Zoœcial area subrhomboidal, broad (0″·02 to ·025). Border thin and sharp. Lamina concave, with a large oval opening on each side above. Surface very finely punctate. Orifice semicircular, with a straight entire lower lip. Peristome thickened all round, but especially above, where it is strongly beaded. A small articulated marginal spine on each side of the summit. On the lower part of the front a very large and prominent avicularium, with an acute, incurved, uncinate mandible, pointing obliquely upwards—a correspondingly curved acute beak. Oœcia large, prominent, with a sinus or notch on each side at the bottom (not shown in the figure), and finely punctate.

Habitat.—Station 135c, off Nightingale Island, 110 to 150 fathoms, and (135a), off Inaccessible Island, Tristan da Cunha, 75 to 90 fathoms, hard ground, shells, gravel.

(2) *Micropora coriacea*, Esper (sp.).

Flustra coriacea, Esper.
Discopora coriacea, Lamk., Lamx., Blainv.
Micropora coriacea, Gray, Smitt, Hincks.
Membranipora coriacea, Brit. Mus. Cat.

Character.—Front broadly elliptical; margin terminating on each side of the orifice in a usually small (sometimes large) tubercle. Lamina punctate, occasionally with a perforation on each side close below the orifice. Orifice semicircular, with a straight entire lower lip. Oœcia subimmersed, with an umbonate projection in front.

Habitat.—Station 135a, off Inaccessible Island, Tristan da Cunha, 75 to 90 fathoms, hard ground, shells, gravel (on shell). Station 75, lat. 38° 38′ N., long. 28° 28′ W., 450 fathoms.

[Shetland, Antrim, Cornwall, Guernsey, Hastings, Caithness; Gulf of Florida, 36 to 135 fathoms, Pourtalès.]

2. *Vincularia*, Defrance.

Vincularia, Defrance; d'Orb.; Stoliczka; Brit. Mus. Cat., &c. (all in part) *nec* Smitt; *Cellaria*, *Eschara*, *Membranipora*, *Steganoporella*, &c., &c., Auctt.

Character.—Zoarium erect, continuous, branched or simple; radicate or fixed. Subcylindrical or polygonal. Zoœcia disposed in alternate longitudinal series. Frontal area quadrangular, oblong, arched above, in the natural state filled in by a chitinous epitheca, in which is seated the oral orifice. Beneath the epitheca a calcareous lamina, occupying the lower two-thirds of the area, and terminating above in a free border, from which a median process arises, which, joining above a process from each side of the zoœcium on a level with the lower border of the orifice, forms with those processes a transverse bridge with an arch on each side of the median process. Opercula incomplete

below, composed of a thickish membrane supported on the inner face by a strong chitinous bow having a projecting process near each lower angle for the attachment of the occlusor muscles. Oœcia represented by a small chamber in the upper part of the cell, which opens above the oral orifice.

Few questions have given rise to more disputation and confusion than as to what should be understood under the term *Vincularia*. I am not, however, here prepared to enter into this *vexata quæstio*, with respect to which some useful remarks by Mr. Hincks will be found in one of his communications on the Family Microporidæ.[1]

The above definition, therefore, is only proposed provisionally, and it is here intended to restrict the term to cylindrical or rather polygonal, continuous growths, partaking of the characters of *Micropora* and *Steganoporella*, and intermediate, as it were, between those two genera, and forming with them the Family Microporidæ; differing from *Micropora* chiefly in the conformation of the oral orifice and the absence of distinct oœcia, and from *Steganoporella* in the cavity of the zoœcium not being divided into two chambers, in the incompleteness of the operculum, and its simpler chitinous framework, the absence of the two suboral chitinous trabeculæ, &c

(1) *Vincularia gothica*, d'Orbigny (Pl. XXIII. fig. 1).

Vincularia gothica, d'Orb., Palæont. Franç., p. 68, pl. dcliv. figs. 13–16.
„ *novæ hollandiæ*, Haswell, Proc. Linn. Soc. New South Wales, p. 41, pl. iii. fig. 3.
„ *steganoporoides*,[2] Macgilliv., New Species of Bryozoa from the Marion Islands, Proc. Roy. Soc. Victoria, June 1881, p. 6, pl. ii. fig. 5.

Character.—Zoarium furcately branched, octagonal. Zoœcia elongate, arched above, straightly truncate at bottom; border smooth. Primary or epithecal orifice semicircular or subcrescentic. Lamina occupying the lower two-thirds of the area. Its upper border somewhat incurved. On a level with the upper border of the lamina a tooth-like process springs from each side of the zoœcium, which gradually elongating meet in the mesial line, where they are joined by a median process or denticle, which rises gradually from the upper border of the lamina, thus forming a bridge with two arches and a thick central pier. Surface of bordering ridges and lamina perfectly smooth and imperforate. Oœcia and avicularia 0. Operculum 0″·013 × ·0085 incomplete below, membrane thick, supported on the inner face near the border by a very strong chitinous arched bow,

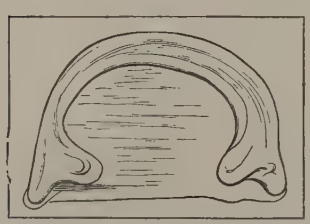


Fig. 2.—*Vincularia gothica.*

[1] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. ix., 1882, p. 119.

[2] Mr. Hincks (Gen. Hist. Mar. Polyz., *Ann. and Mag. Nat. Hist.*, ser. 5, vol. ix. p. 119, 1882) seems to regard this as a form of his *Steganoporella smittii* (Brit. Mar. Polyz., vol. i. p. 178), which, however, I should myself refer to the genus *Micropora*. It is clearly quite distinct from Mr. Macgillivray's species.

having a hooked process projecting at each lower angle for the attachment of the occlusor muscles.

Habitat.—Prince Edward Island, 80–150 fathoms.

[Marion Island.]

(2) *Vincularia gothica*, var. *granulata*.

Slenderer habit; surface of ridges and lamina granular. Operculum more rounded and the chitinous arch not so strong.

Habitat.—Station 151, off Heard Island, 75 fathoms, volcanic mud.

Whether this should be regarded as a variety or raised to the rank of a distinct species may be a matter of doubt. The difference in the character of the surface is very marked, as well as the slenderer habit. As the collection affords numerous specimens, it may, however, be observed that no apparently transitional forms are met with.

(3) *Vincularia labiata*, n. sp.

Character.—Zoarium furcately branched; branches octagonal. Zoœcial area oblong, contracted below or subovate, acutely arched above. A projection immediately below the oral orifice. Lamina imperforate, surface finely granular. The transverse bridge below the internal orifice formed in the same way as in *Vincularia gothica*, except that the central pier, instead of rising from the upper edge of the lamina, commences above from the conjoined lateral process, and gradually descends to become anchylosed to the lamina. This descending process is very rough and irregular in outline. Operculum 0″·013 × ·007 semicircular or subcrescentic, with a very slender chitinous border and an internal chitinous arch seen on the posterior aspect, with a hooked process at each end for the attachment of the occlusor muscles.

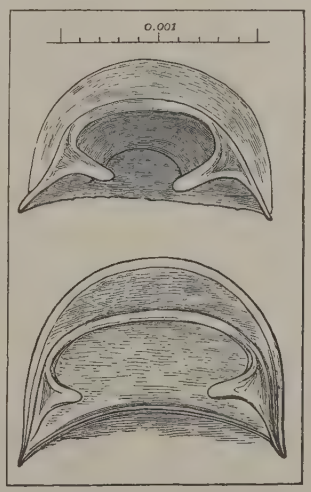


Fig. 3.—*Vincularia labiata.*

Habitat.—Station 320, lat. 37° 17′ S., long. 53° 52′ W., 600 fathoms, green sand.

This species may be at once distinguished from the preceding by the strong projection forwards of the oral bridge, which is quite obvious even before the removal of the chitinous epitheca; and it is curious to observe that the median process or pier of the bridge, instead of rising up from the lamina, descends from above and does not begin to be formed before the junction of the lateral arches.[1]

[1] As the last two forms were not at first distinguished from *Vincularia gothica*, no figures of them have been prepared.

3. *Steganoporella*, Smitt.

Steginoporella, Smitt, Florid. Bryoz.
Steganoporella; Hincks, Brit. Mar. Polyz.; Waters; Macgilliv.
Membranipora (pars), Brit. Mus. Cat.; Auctt.
Vincularia (sp.), d'Orb.

Character.—Zoarium polymorphous; erect and branched or lobate; or decumbent, and foliaceous and crustaceous. Zoœcia oblong, arched above. Frontal area occupied by a delicate chitinous membrane, which is closely adnate to the internal calcareous lamina for about the lower half of the area; above free, and supporting the operculum, and having on each side, below the orifice, a minute forked or irregularly branched vertical chitinous rod. Opercula large, semicircular, usually of two kinds, the membranous portion supported by a branching chitinous framework. A strong internal calcareous lamina, which, about the middle of the length of the cell, bends backwards to the posterior wall, forming a transverse diaphragm, by which the cell is divided into two distinct chambers, communicating by a phrenic opening through which the polypide is protruded supported on or passing over a large hollow process rising from the upper and anterior part of the transverse diaphragm.

The very peculiar conformation of the zoœcium in this genus or subgenus is not very easily described. It may be briefly said that the general cavity of the zoœcial cell is divided into two chambers, an upper, probably oœcial in function, in the fertile cells, and an inferior, in which the polypide is lodged. This division into two chambers is effected by the bending backwards of the calcareous lamina, which, instead of ceasing with a free border as in *Vincularia* (*mihi*), is apparently attached all round to the sides and back of the general zoœcial cavity, but leaving posteriorly a rather large opening, through which the polypide is extruded along an imperfectly tubular passage which bends forwards to the orifice, and is supported beneath by a very peculiar hollow process rising from the convex upper surface of the diaphragm.

The space, therefore, of the upper chamber, on each side of the diaphragmatic opening and supporting fulcrum, forms a vaulted cavity occupying the upper half of the entire cell, and no doubt, as has been suggested, serving as an oœcial receptacle. There are no other distinctly oœcial organs. In two out of the three existing species of the genus, limited as above, with which I am myself acquainted, this upper or oœcial compartment is more developed in some of the zoœcia than in others, and the difference is marked by a difference in the size and pattern of the chitinous framework of the operculum. In the third species, a New Zealand form, which I have termed *Steganoporella neo-zelanica*,[1] which does not occur in the Challenger collection, there is, however, no marked difference between the opercula of different cells. Other peculiarities, not at first sight so obvious

[1] *Quart. Journ. Micr. Sci.*, N. S., vol. i. p. 155, pl. xxxiv. fig. 4.

as the above, are:—The existence in the chitinous epithecal membrane, on each side close below the mouth, in all three species known to me, of a very minute chitinous furcate spiculum, as it may be termed, which is lodged within the thickness of the epithecal membrane. These spicula are probably to some extent homologous with the chitinous trabeculæ on each side the orifice in all the Salicornariadæ, and which in that Family serve as supports for the articulation of the elaborate opercula with which all its members are furnished. Another circumstance should also be mentioned, though not as by any means a distinctive character, as it will probably be found of frequent occurrence, viz., the existence of a delicate chitinous hollow filament, which also, as in the Salicornariadæ, follows the contour of the frontal areas, and is apparently continuous throughout the zoarium, serving, it may be imagined, as a channel of communication throughout the entire zoarium, or where the latter is divided into internodes, throughout each separate segment.

Steganoporella magnilabris, Busk (sp.) (Pl. XXIII. fig. 2).

Membranipora magnilabris, Bk., Brit. Mus. Cat., p. 62, pl. lxv. fig. 4.
Steginoporella elegans, Smitt, Florid. Bryoz. (*nec. Eschara elegans*, M. E.).
Steganoporella magnilabris, Hincks; Waters; Macgilliv., Nat. Hist. Vict., Dec. vi. p. 43, pl. lx. fig. 1.
? *Biflustra crassa*, Haswell.
Steganoporella neo-zelanica (sp.), Waters.

Character.—Zoarium polymorphous; erect, foliaceous, expanded or branched, uni- or bi-laminar (escharine form); or subcrustaceous or decumbent (membraniporidan form); or tubular (siphonella-form). Zoœcia oblong, arched above; border thick, rounded, granular, usually a broad tooth-like articular projection on each side about the middle. In the natural state, the frontal area is covered in by a delicate chitinous membrane, the upper half of which is free and contains the external oral orifice and operculum, and towards each side a minute furcate trabecula; the lower half closely adnate to the subjacent calcareous perforated lamina. Opercula suborbicular, of two kinds, one larger (oœcial ?), in which the membrane is supported by a chitinous framework, consisting of two convergent rods; and the other smaller (zoœcial), in which the rods are represented by a continuous chitinous bow. In both the margin of the operculum is furnished on the posterior aspect with a row of acute, conical, flexible spicules.

Habitat.—Off Honoruru, Sandwich Islands, 20 to 40 fathoms (ramose or escharine form).

[Abrolhos Islet, Darwin; Algoa Bay, Bowerbank; Port Dalrymple, Voy. of Rattles., (hemescharine form); Gulf of Florida, Pourtalès (escharine- and siphonella-forms), Smitt; ? Miocene fossil, Gipps Land, Waters (escharine form); Tongatabou, Sir E. Home.]

In his account of the Floridan Bryozoa, Professor Smitt gives *Eschara elegans* of

M. Milne-Edwards as a synonym of this species, but in this view I am quite unable to support him, agreeing in that respect with Mr. Waters and Mr. Macgillivray, and I presume also with Mr. Hincks. Mr. Waters,[1] again appears to regard it as synonymous with my *Vincularia* (*Steganoporella*) *neo-zelanica*, from which, however, it is quite dis-

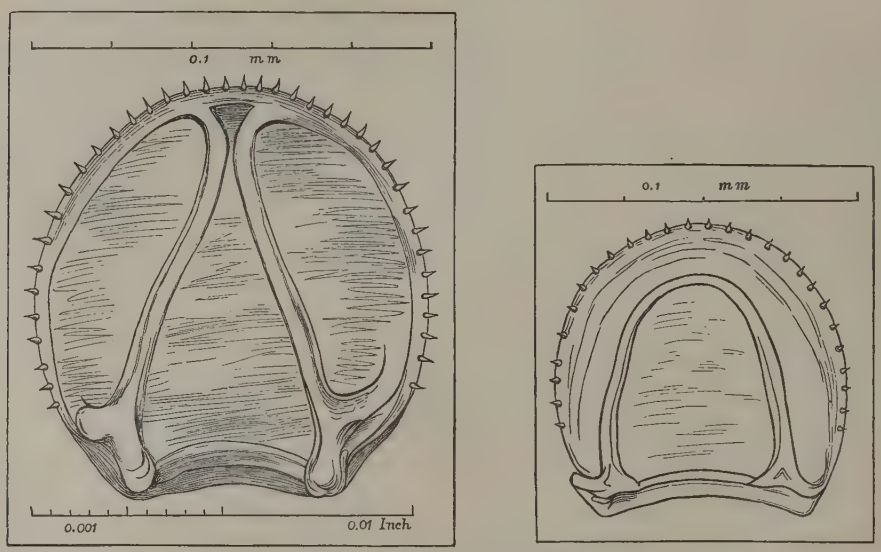


FIG. 4.—*Steganoporella magnilabris.*

tinct, as may be seen in several points of their structure, and very readily in the opercula, which in *Steganoporella neo-zelanica* are all of one kind, and present a totally different pattern in the chitinous framework, &c.[2]

4. *Caleschara*, Macgillivray.

Caleschara, Macgilliv., Nat. Hist. Vic., Dec. v. p. 45.
Membranipora (sp.), Hincks, Ann. and Mag. Nat. Hist., ser. 5, vol. vii. p. 152, 1881.

Character.—Zoarium polymorphous; erect, foliaceous and contorted, or composed of ligulate branches and bilaminar; or decurrent and encrusting. Zoœcial area pyriform; the margin very thick and bevelled off to a considerable depth, so as to leave a very contracted elliptical aperture, at first membranous, but eventually occupied in the lower two-thirds by a calcareous lamina attached below to the bottom of the aperture, and above by a broad band to each side, and leaving on either side an elongated fissure. The upper third above the lamina represents the internal or secondary oral orifice. In the

[1] *Geol. Journ.*, Nov. 1882, p. 506, pl. xxii. figs. 7–7*a*.
[2] Several fine specimens of this species, in the hemescharine state, are in the British Museum.

natural state the entire area is filled in by a rather thick epithecal membrane, in which alone is seated the semicircular or subcrescentic operculum. Fertile cells distinguished by their greater width.

This curious type appears to have been first noticed by Mr. Macgillivray, who describes the zoarium in his specimens as "small, foliaceous, and convoluted," and Mr. Hincks as "foliaceous and bilaminar or incrusting." The few fragmentary specimens in the Challenger collection, on the other hand, represent portions of a small zoarium, composed of narrow, compressed ligulate branches, dividing irregularly in a furcate manner. The zoœcial character, however, in the main corresponds so exactly with that given to *Caleschara denticulata* by Mr. Macgillivray and Mr. Hincks, as apparently to reduce the Challenger form to a mere variety of that species.

With respect to the systematic position of *Caleschara*, opinions may well be divided, its characters at different stages of growth passing from those of a simple *Membranipora*, through *Amphiblestrum* to *Micropora*, with which latter genus it is very closely allied, differing in fact almost solely in the absence of a complete calcareous border round the mature oral orifice. On the whole, and taking the characters from the fully matured condition, I am disposed to agree with Mr. Macgillivray in thinking it worthy at any rate of subgeneric rank.

Caleschara denticulata ?, var. *tenuis* (Pl. XXI. fig. 9).

Character—Zoarium erect, composed of narrow, ligulate, compressed, bilaminar branches. Frontal areas pyriform, separated by very wide, bevelled ridges, and deeply depressed in the middle, where an elliptical aperture is left, occupied in the lower two-thirds by a thick calcareous lamina attached below to the lower border of the aperture, and on each side above to its sides, leaving on either side an elongated fissure. The edges of the lamina toothed, and its surface, as well as that of the interzoœcial ridges, strongly granulated.

Habitat—Station 162, off East Moncœur Island, Bass Strait, 38 fathoms, sand and shells.

[Var. *foliacea* and *crustacea*, Queenscliff and Victoria, Mr. Watts; Curtis Island, Bass Strait, Captain Warren.]

Family XII. Electrinidæ.

Electrinidæ, d'Orb., 1851, Palæont. Franç., p. 329.
Membraniporidæ (pars), Auctt.

Character—Zoarium erect or incrusting, more or less flexible or subtestaceous. Zoœcia turbinate or subturbinate. Wall punctured. A wide expanding aperture, the

border toothed or furnished with chitinous aculeate spines. One or more chitinous spines of larger size than the rest articulated on the front of the zoœcium below the aperture, or an articulated avicularian process in the same situation. Œcia when present galeate.

Electra, Lamouroux.

Electra, Lamx., 1816; d'Orb., 1851.
Electrina, *Reptelectrina*, d'Orb.
Flustra, sp., Gmelin; Bosc; Ell. and Soland.; Lamk.; Lister, &c.
Sertularia (pars), Linn., Esper.
Membranipora (pars), Auctt.
Annulipora, Gray.
Eschara (sp.), Pallas.

Character.—That of the Family.

The very peculiar conformation of the species included in the genus *Electra* seems to me amply sufficient to justify its erection into the type of a distinct Family, as proposed thirty years ago by M. d'Orbigny.

Three or four, or perhaps five, species have been described, which may be included in it, viz. :—

Electra pilosa, (Linn.).
,, *verticillata*, Lamx.
,, *triacantha*, Lamx.
,, *bellula*, Hincks.
,, (?) *distorta*, Hincks.

The last must perhaps be regarded as an aberrant form. To these the Challenger collection has made one addition, which, however, differs so widely from the others that it might with some reason be regarded as more than specifically distinct.

Electra cylindracea,[1] n. sp. (Pl. XXXIII. fig. 2).

(*Nec*, *Electra cylindrica*, d'Orb.).

Character.—Zoarium radicate, cylindrical, simple or branched. Zoœcia disposed in annular series round an imaginary axis and very closely crowded. Front pyriform, wide above and much contracted below. Border of aperture thin, smooth, with a straight ascending chitinous spine on each side at the top; and close below these two thick clavate, curved spines or horns. Aperture wide, rounded or oval. Oral orifice very wide,

[1] When I put the appellation at the bottom of the plate, I had overlooked the circumstance that d'Orbigny had already employed the same name "*cylindrica*" for what is probably merely a variety of *Electra verticillata* or of *Electra pilosa*.

close to the summit. At the bottom of the aperture a large upright hollow process with a circular opening surrounded by a very thick granular border and having on one side a large avicularium with an acute falciform mandible, and furnished round the base with several irregularly furcate chitinous processes. Each zoœcium crowned with an avicularium with an acute triangular mandible pointing upwards. Oœcia galeate, each crested with an avicularium on a short cylindrical peduncle; and having a radiate pore in front, immediately above the opening.

Habitat.—Prince Edward Island, 80 to 150 fathoms.

From the densely crowded way in which the cells are disposed, and the manner in which they are concealed by the spines and curious frontal avicularian processes, I have not been able to give an accurate figure of them *in situ*, but those given may perhaps suffice to render the description more intelligible. This is one of the most remarkable forms among the Polyzoa.

Group C. ESCHARINA.

Family XIII. Bifaxariadæ.

Character.—Zoarium rigid, continuous or articulated, biserial, variously branched. Zoœcia alternate, closely connate back to back and facing in opposite directions.

The Family here contains the following genera :—

1. *Bifaxaria*, n. gen.
   - § *α. articulatæ.*
     - (1) *Bifaxaria submucronata*, n. sp. (Pl. XIII. fig. 1).
     - (2) *Bifaxaria lævis*, n. sp. (Pl. XIII. fig. 2).
   - § *β. inarticulatæ.*
     - (3) *Bifaxaria corrugata*, n. sp. (Pl. XIII. fig. 3, and Pl. XXIV. fig. 6).
     - (4) *Bifaxaria papillata*, n. sp. (Pl. XIII. fig. 4, and Pl. XXIV. fig. 4).
     - (5) *Bifaxaria minuta*, n. sp. (Pl. XIII. fig. 5).
     - (6) *Bifaxaria reticulata*, n. sp. (Pl. XIII. figs. 6 and 8).
     - (7) *Bifaxaria abyssicola*, n. sp. (Pl. XXIV. fig. 5).
     - (8) *Bifaxaria denticulata*, n. sp. (Pl. XXIV. fig. 3).
2. *Calymmophora.*
   - *Calymmophora lucida*, n. sp. (Pl. XXXII. fig. 3).

1. *Bifaxaria*, n. gen.

Character.—Zoarium continuous or segmented, variously branched, rooted by radical tubes. Zoœcia biserial, alternate, facing bifariously on the two sides, very closely

contiguous. Orifice elliptical from side to side, or semiorbicular or suborbicular. Peristome sometimes subtubular, sometimes deeply immersed. A small circular immersed avicularium on each side of the orifice, sometimes wanting, or replaced by a short, hollow, spinous process. Oœcia, when present, deeply imbedded in the superjacent zoœcium. A raised ridge or keel on the middle of the front, the upper pointed termination of which constitutes a more or less prominent mucro in front of the orifice.

§ *α. articulatæ.*

(1) *Bifaxaria submucronata*, n. sp. (Pl. XIII. fig. 1).

Character.—Zoarium candelabriform, 1 to 2 inches high. Zoœcia subcarinate in front. Orifice horizontal, wide transversely, lower or anterior border submucronate. Surface sparsely punctured in vertical rows. One or two raised lines down the sides. Avicularia small, cup-shaped, circular; mandible semicircular.

Habitat.—Station 122, lat. 9° 5′ S., long. 34° 50′ W., 350 fathoms, red mud.

(2) *Bifaxaria lævis*, n. sp. (Pl. XIII. fig. 2).

Antipathes humilis, Agassiz and Pourtalès, Hassl. Exped., 1874, p. 8, pl. ix. fig. 9.

Character.—Zoarium candelabriform, 1 to 2 inches wide. Zoœcia completely immersed but very convex, square or flattened in front with an acute keel, obscurely punctured. Orifice small, semicircular and slightly sinuate in front. Avicularia small, circular or oval, mandible semicircular, completely immersed some distance from the orifice and on the same level. Oœcia inconspicuous.

Habitat.—Station 214, lat. 4° 33′ N., long. 127° 6′ E., 500 fathoms, blue mud.

§ *β. inarticulatæ.*

(3) *Bifaxaria corrugata*, n. sp. (Pl. XIII. fig. 3, and Pl. XXIV. fig. 6).

Character.—Zoarium continuous; branched bifariously, branches alternate, equidistant, straight, short. Zoœcia from 0″·02 to 0″·03 long, ventricose. Surface strongly wrinkled, with a slender keel in front, and finely perforated only on the front. Orifice transverse, upper border projecting, lower broad with a pointed hook (when perfect) on each side and a smaller one in the middle (being the termination of the keel). A small circular avicularium at each angle of the orifice, and occasionally a large one projecting in the form of a conical papilla from the side of a zoœcium (Pl. XXIV. fig. 6).

Habitat.—Station 122, lat. 9° 5′ S., long. 34° 50′ W., 350 fathoms, red mud.

(4) *Bifaxaria papillata*, n. sp. (Pl. XIII. fig. 4, and Pl. XXIV. fig. 4).

Character.—Zoarium branched bifariously, branches opposite, curved, ascending, with short secondary branches. Zoœcia urceolate, square in front with a slight mesial keel and a ridge on each side, all three terminating at the anterior border of the orifice in small spinous processes. Anterior wall entire; two rows of distant punctures on the sides, one of three or four small ones close to the border, and the other of as many larger ones down the middle of the side. Oral angular avicularia very minute and often absent altogether. On the older zoœcia a papilliform avicularium with an elliptical or subtriangular mandible. Oœcia deeply immersed, often with a very large conical eminence on both sides, on the under side of which is an avicularium with an elliptical mandible.

Habitat.—Station 196, lat. 0° 48′ S., long. 126° 58′ E., 825 fathoms, hard ground.

Having much the same habit as *Bifaxaria corrugata*, the present differs from that form,—1. In its much smaller size; 2. In having the branches curved instead of straight; 3. In the branches being opposite, and also in that the primary give off secondary branches; and 4. In the shape of the zoœcium, which is flattened or square in front and imperforate, though with punctures on the sides. In the older cells one of these punctures appears to become elevated into a papilliform avicularium, which in some cases attains an enormous development on the sides of the oœcia and sometimes on one of the ordinary zoœcia (Pl. XXIV. fig. 4*d*).

The lateral puncta are concealed under the epitheca and were overlooked when the drawing was made (Pl. XIII. fig. 4).

(5) *Bifaxaria minuta*, n. sp. (Pl. XIII. fig. 5).

Character.—Zoarium very small (probably); zoœcia fusiform; orifice semicircular; a circular immersed avicularium on each side close to the orifice. A thin ridge down each side towards the front and a septal ridge between the two series of zoœcia; five or six small punctures close to the septal ridge.

Habitat.—Station 70, lat. 38° 25′ N., long. 35° 50′ W., 1675 fathoms, Globigerina ooze.

The only specimen in the collection is a very small fragment, including the lower part of the zoarium and the bundle of radical fibres by which it was affixed to *Globigerina* shells. The state of the specimen does not afford any clue to the habit of the growth, but it was doubtless of only small size.

(6) *Bifaxaria reticulata*, n. sp. (Pl. XIII. figs. 6 and 8).

Character.—Zoarium ? Zoœcia fusiform, orifice orbicular, with a minute mucro in front, afterwards tubular, and eventually furnished with a wide lip on each side. A raised septal line between the series. In the older zoœcia a short spine in the angle at each side of the orifice. A row of five or six punctures on each side close to the septal ridge.

Habitat.—Station 13, lat. 21° 38′ N., long. 44° 39′ W., 1900 fathoms, Globigerina ooze.

The wall of the zoœcial cells is very finely cancellated or reticulated (fig. 6*b*).

This species is also represented only by two or three small fragments, so that what its general habit may be is uncertain.

(7) *Bifaxaria abyssicola*, n. sp. (Pl. XXIV. fig. 5).

Character.—Zoarium (about 1 inch high) slender, cylindrical, branched, arising from a bundle of radical fibres. Zoœcia completely immersed. Surface coarsely rugose; orifice immersed, narrow, transverse, lower or anterior lip slightly prominent. Avicularia small, disposed in a single row on either side, on slightly elevated rostriform papillæ. Mandible semicircular pointing upwards or sideways.

Habitat.—Station 253, lat. 38° 9′ N., long. 156° 25′ W., 3125 fathoms, red clay.

Specimen very imperfect.

(8) *Bifaxaria denticulata*, n. sp. (Pl. XXIV. fig. 3).

Character.—Zoarium 1 to 1·5 inches high, irregularly branched in one plane. Zoœcia, though bifarious, tend to face one way. Surface closely punctured in the younger zoœcia, wrinkled in the older. Orifice horizontal, with a prominent bifid lower or anterior lip. A small avicularium looking inwards on one side of the median sinus of the lower lip, with an acute triangular mandible pointing upwards.

Habitat.—Station 320, lat. 37° 17′ S., long. 53° 52′ W., 600 fathoms, green sand.

2. *Calymmophora*, n. gen.

Character.—Zoarium continuous, irregularly branched; biserial; the zoœcia alternate, placed back to back facing in opposite directions, pyriform, squarely truncated at the top, with a hollow conical process at each angle, often supporting a small avicularium. Orifice large, orbicular, with a wide notch in front, terminal (looking directly upwards). Oral valve semicircular, curved transversely, with numerous perforations. Wall exceed-

ingly delicate, with a very slender median and two lateral ridges, and a row of very distant pores on each side and a few of smaller size on the sides and below the orifice. Oœcium galeriform, completely immersed in front of the superjacent zoœcium, and covered with the general epithecal membrane, with which the entire growth is enveloped as in a loose veil.

Calymmophora lucida, n. sp. (Pl. XXXII. fig. 3).

Character.—The only species.
Habitat.—Station 163A, off Twofold Bay, 150 fathoms, green mud.

One great peculiarity in this form is that the external chitinous membrane, or epitheca as it may be termed, which is in fact the remains of the original germinal membrane of which the incipient budding zoœcia are solely formed, is completely detached, except at a few points, from the proper calcified wall, and forms a universal beautifully transparent veil over the entire growth, passing as it were uninterruptedly from one zoœcium to another, and enclosing the oœcia. Another special characteristic is the completely terminal position of the mouth, the oral valve constituting a curved lid, which when open is thrown forwards.

The growth is everywhere as transparent as glass, so that the whole internal economy is visible. The polypide is of comparatively small size compared with the capacity of its habitation, and presents nothing unusual, except that there is no ventricular diverticulum, nor any distinct œsophagus nor pharynx. The retractor muscles do not appear to be either striated or nucleated, and there is no appearance of a so-called funiculus, nor in fact of any structures within the cavity beyond the retractor muscular fibres.

The extreme delicacy and transparency of the textures make it advantageous to employ some colouring agent in the examination.

Family XIV. Salicornariadæ.

Salicornariadæ (pars), Bk., Brit. Mus. Cat.
Salicornariidæ (pars), Bk., Crag Polyz.
Salicornaridea (pars), Reuss.
Cellarieæ (pars), Smitt.
Cellaridæ, Escharellinidæ, &c., d'Orb.
Cellariidæ, Hincks, &c.

Character.—Zoarium erect, radicate or fixed; simple, branched, or lobed; segmented or continuous; cylindrical, with the cells disposed round an imaginary axis, or compressed and bilaminar. Surface areolated. Zoœcia completely immersed, each corresponding to an area; front depressed, usually concave. Orifice crescentic, semi-

circular, or elliptical. Oœcia inconspicuous, opening at or near the summit of the area above the orifice. In the decalcified condition the interareolar septa exhibit a delicate chitinous probably tubular filament apparently continuous throughout the segment; and on each side of the oral orifice a slender curved chitinous rod or trabecula, which sometimes unite so as to form a complete or incomplete ring. Avicularia usually present, either vicarious or intercalated.

The Family Salicornariadæ, as thus constituted, appears to be a very natural one. It includes besides *Salicornaria* or *Cellaria*, the genus *Melicerita* of M. Milne-Edwards, the close relationship of which to *Salicornaria* has also been perceived by Mr. Waters.[1]

Under the name *Salicornaria* I have included all the cylindrical forms, though strongly inclined to separate *Salicornaria magnifica* from the rest, on account of its unjointed branched zoarium, and the absence, so far as I have been able to perceive, of any avicularian organs.

As in very many other cases, the chitinous elements of the skeleton will in this Family be found of the utmost value in diagnosis, as affording the most distinct and invariable characters. Among these elements are included, besides the opercula and avicularian mandibles:—1. A delicate, sometimes distinctly tubular filament, running along the interareolar septa, and affording probably a channel through which the extension and calcification of the septa are effected. This filamentary network appears to be continuous throughout the branch or internode, and the network formed by it should be regarded as zoarial rather than as appertaining to the individual zoœcia enclosed in the meshes.

2. A second chitinous element, peculiar, so far as I am aware, to this Family, consists in the delicate rods or trabeculæ on either side of, or completely surrounding the orifice and its operculum, to which the rods or ring afford support. It may be added that these trabeculæ or the analogous chitinous ring are plainly visible, in many cases without any previous decalcification. This is especially seen in *Salicornaria magnifica* and *Melicerita atlantica*. They appear to lie beneath the common epitheca and not to form mere thickenings of it.

A further peculiarity, common, so far as I know, to the whole Family, is the existence of a rounded apparent opening at each lower angle of the operculum, and which in the descriptions of several species are termed "foramina." Subsequent examination, however, seems to show that these marks are not really openings, but in all probability merely the optical expression of the bases of short conical projections on the dorsal surface of the operculum—a sort of levers—for the attachment of the occlusor muscles.

[1] *Quart. Journ. Geol. Soc.*, August, 1881, p. 332.

The Family here contains the following genera :—

§ 1. *cylindricæ.*

1. *Salicornaria.*

α. simplices.

(1) *Salicornaria clavata*, n. sp. (Pl. XII. fig. 8).

β. articulatæ.

(*a*) *tubulatæ.*

(2) *Salicornaria simplex*, n. sp. (Pl. XXXIII. fig. 8).

(*b*) *nodatæ.*

(3) *Salicornaria variabilis*, n. sp. (Pl. XII. figs. 3–9).
(4) *Salicornaria divaricata*, n. sp., woodcut 4.
(5) *Salicornaria bicornis*, n. sp. (Pl. XXXIII. fig. 9).
(6) *Salicornaria dubia*, n. sp. (Pl. XII. fig. 2).
(7) *Salicornaria malvinensis*, Busk (Pl. XII. figs. 1, 5, 7).
(8) *Salicornaria tenuirostris*, Busk.
(9) *Salicornaria gracilis*, Busk.

γ. inarticulatæ.

(10) *Salicornaria magnifica*, n. sp. (Pl. XII. figs. 4, 6).

§ 2. *compressæ.*

2. *Melicerita.*

(1) *Melicerita atlantica*, n. sp. (Pl. XIV. fig. 1).
(2) *Melicerita dubia*, n. sp. (Pl. XXXIII. fig. 10).

§ 1. *cylindricæ.*

1. *Salicornaria*, Cuvier.

Salicornaria, Cuvier; Johnst.; Brit. Mus. Cat.; Stoliczka, &c., &c.
Salicornia, Schweigger.
Cellaria (pars) Lamx.; Solander, &c.
„ Lamk.; Smitt; d'Orb.; Hincks, &c.
Farcimia, Fleming.
Cellularia (pars), Pallas; Bruguière, &c.
Glauconome (pars), Münster.
Vincularia (pars), d'Orb.; Roemer, &c.

Character.—Zoarium radicate, simple or branched, articulated or continuous; cylindrical, with the cells disposed round an imaginary axis; with or without avicularia

When articulated the internodes are connected either by short straight tubes, or with the intervention of a convoluted knot of slender tubules.

The recent species of this genus, as above defined, with which I am acquainted, are about fifteen to seventeen in number, and they admit of being conveniently and more or less naturally grouped as under :—

α. *simplices.*—In which the zoarium is simple, or composed, as it may be said, of a single segment, from which, however, loosely connected offsets sometimes spring irregularly, attached to the parent stock either by ordinary clasping filaments, or sometimes by a single, rather long tube arising from the front of a zoœcium, when the young offset or branch may be regarded as homologous with the chitinous tubes resembling radical fibres presented in several species, which spring in a similar manner from the front or other part of a cell in other species of *Salicornaria*, as, notably, *Salicornaria pilosa*, Kirch., and *Salicornaria bicornis*, Bk., as well also as in many other species belonging to several genera. The only species in which this condition is very distinctly shown is *Salicornaria clavata*, n. sp.; there is, however, a small form from the Adriatic, termed by M. Costa *Salicornaria gracilis*, but which seems to me to be distinct, in which the same habit would appear to be present.

β. *articulatæ.*—In which the internodes are connected by elastic or flexible joints, and always arise in pairs, so as to constitute a dichotomous growth. These forms may again be subdivided into—(*a*), those in which the bond of union between the segments consists of more or less numerous, short, thick-walled, chitinous tubes which are continuous at either end with the delicate endocyst of the terminal cells in the superior and inferior internodes; and (*b*), those in which the connection is effected with the intervention of what Prof. Smitt terms a "knot of intricated radical tubes." The precise mode of connection between this "knot" and the three internodes between which it forms the bond of union, I have not been able satisfactorily to determine, but so far as I can perceive one or two tubes arise from the summit of the inferior internode, and form an intricate plexus, which is lodged between the two superior segments, and gives off a single tubule to each. The junction, consequently, so far as the chitinous element is concerned, appears to be slight, though highly elastic. In most of the species thus furnished it should, moreover, be remarked that the calcareous walls of the contiguous internodes above and below are very closely applied to each other, so as to appear continuous, but I have not met with any case in which they are really so. The species belonging to this category are much more numerous than those in the other, and for the most part apparently confined to the southern hemisphere, the only apparent exception to this being *Salicornaria johnsoni*, which occurs also in the northern.

It is worthy of remark that this difference in the manner of articulation appears to be connected with other characters distinctive of the respective groups.

Speaking generally, the species of *Salicornaria* may also be grouped into those in which the areolation is fundamentally rhomboidal, and those in which it is strictly hexagonal. In both, in certain states, pyriform areas are common, more especially in the younger parts; and the rhomboidal areas very commonly become hexagonal by the truncation of the upper and lower angles, whilst in the truly hexagonal forms the upper and lower angles of the area are acute, and it is very rare, I think, to meet with the true hexagon in a rhomboidal species; but this occurs sometimes in *Salicornaria sinuosa*. In connection with these two fundamental types of areolation, it would appear that the rhomboidal form occurs in those species in which the articulation is by straight tubes, whilst the true hexagonal areolation is characteristic of those in which the nodular connection exists.

The known species in which the areolation is fundamentally rhomboidal and the articulation tubulate, are:—

(1) *Salicornaria farciminoides*, Cuvier.
(2) *Salicornaria sinuosa*, Hasswell.
(3) *Salicornaria simplex*, n. sp. (Pl. XXXIII. fig. 8).
? (4) *Salicornaria crassa*, n. sp.
? (5) *Salicornaria hirsuta*, Kirchenpauer.

Whilst those in which the areolation is originally hexagonal and the articulations nodular are:—

(6) *Salicornaria variabilis*, n. sp.
(7) *Salicornaria aciculata*, n. sp.
(8) *Salicornaria bicornis*, Busk.
(9) *Salicornaria dubia*, n. sp.
(10) *Salicornaria malvinensis*, Busk.
(11) *Salicornaria tenuirostris*, Busk.
(12) *Salicornaria johnsoni*, Busk.
(13) *Salicornaria johnsoni*, var. *gracilis*, Busk.
? (14) *Salicornaria hexagonalis*, n. sp.

γ. inarticulatæ.—The only cylindrical branching form with which I am acquainted, in which the growth of the branches is absolutely continuous and without the least indication of segmentation is:—

(15) *Salicornaria magnifica*,

which is further distinguished by the entire absence of avicularia.

As regards the bathymetrical and geographical distribution of the Challenger Salicornariadæ, it may be stated that the former extends from 5 to 1950 fathoms; and as

regards the latter, that the North Atlantic region afforded 2 species; the South Atlantic, 4 species; the South Indian or Kerguelen region, 2–3 species; Australian, 2 species. None seem to have occurred in the Philippine or Pacific regions.

α. simplices.

(1) *Salicornaria clavata*, n. sp. (Pl. XII. fig. 8).

Cellaria fistulosa, Macgillivray, Nat. Hist. Vict.; Dec. v. p. 47, pl. xlix. fig. 1 (*nec* Linn.).
" " var. *australis*, Hincks, Ann. and Mag. Nat. Hist., ser. 5, vol. xiii. p. 368, 1884.

Character.—Zoarium radicate, either simple and clavate, or with irregular loosely attached branches or offsets. Areas rhomboidal or sometimes truncato-hexagonal. Surface smooth. Orifice crescentic, lower lip prominent. Avicularia intercalated, mandible semicircular, 0″·002 × ·0055, with a central opening and subbasal tubercle. Operculum, 0″·006 × ·0045, semicircular, crescentic below, with a wide granulated band.

Fig. 5.—*Salicornaria clavata.*

Habitat.—Station 149D, Royal Sound, Kerguelen Island, 28 fathoms, volcanic mud. Station 151, off Heard Island, 75 fathoms, volcanic mud. Station 162, off East Moncœur Island, Bass Strait, 38 fathoms, sand and shells. Station 163B, off Port Jackson, 35 fathoms, hard ground. Station 304, lat. 46° 53′ S., long. 75° 12′ W., 45 fathoms, green sand. Prince Edward Island.

[Queenscliff, Portland, Maplestone.]

β. articulatæ.

(α) tubulatæ.

(2) *Salicornaria simplex*, n. sp. (Pl. XXXIII. fig. 8).

Character.—Zoarium 1 to 3 inches high, composed of tolerably thick internodes, from $\frac{1}{4}$th to $\frac{1}{2}$ inch long and pretty uniform in length in the same zoarium; branching dichotomously. Areas (in mature parts) rhomboidal or sometimes hexagonal, remarkably regular and uniform. Surface (beneath the epitheca), finely granular. Orifice nearly central, suborbicular, with two pointed denticles above and below. Operculum arcuate, 0″·0055 × ·005, with a branched chitinous support on each side; the lateral trabeculæ meet below the orifice and from the transverse portion three pointed filaments depend. Avicularia (when present) vicarious, with a very large semicircular mandible 0″·0075 × ·0135 pointing upwards.

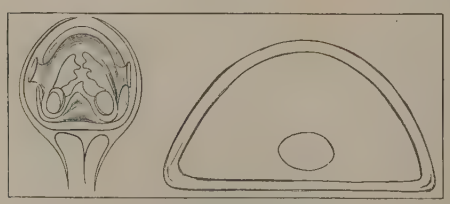


Fig. 6.—*Salicornaria simplex.*

Habitat.—Station 162, off East Moncœur Island, Bass Strait, 38 fathoms, sand and shells.

[New Zealand, Colenso.]

This fine species is at once recognisable by its very peculiar oral chitinous armature, which is quite unlike that of any other species. It is remarkable also for the extreme regularity in size and disposition of the areolation, which is for the most part strictly rhomboidal, but sometimes, as in other cases, becomes hexagonal. In the perfect state the entire surface is covered with a thin epitheca which renders it quite smooth, but when this is removed the aspect is very finely granular. A curious circumstance should be noticed, viz., that in many instances, throughout the whole zoarium, not a single avicularium will be found, so that after examining several specimens of the Challenger collection, I had met with none at all, and had concluded, therefore, that the species was altogether unarmed; but upon examining some fine specimens from New Zealand, where they were procured by Mr. Colenso, to my surprise I found that it did possess very large vicarious ones. So that the name "simplex" I had applied to the form became far less appropriate, though it is perhaps partially justified by the extreme regularity and simplicity of the sculpture. Another peculiarity, so far as I am aware, of the present species, is the fine annulation of the chitinous tubes connecting the segments.

(*b*) *nodatæ*.

(3) *Salicornaria variabilis*, n. sp. (Pl. XII. figs. 3 and 9).

Character.—Zoarium several inches high, composed of elongated unequal internodes, usually incrassated about the middle, and varying much in diameter; joints nodular. Areas rhomboidal, truncato-hexagonal, pyriform or hexagonal; interior ridges inconspicuous or absent; surface smooth. Orifice crescentic, with a prominent lower lip and well-marked internal articular denticles below. Operculum crescentic, with a strongly marked granulated crescentic areola, 0″·005 × ·003; trabeculæ short and small. Avicularia vicarious, mandible subtriangular, with an acuminate membranous point and a central foramen 0″·007 × ·006.

Fig. 7.—*Salicornaria variabilis*.
a, Chitinous areolar filament; *b*, mandible.

Habitat.—Station 304, lat. 46° 53′ S., long. 75° 12′ W., 45 fathoms, green sand. Station 314, lat. 51° 35′ S., long. 65° 39′ W., 70 fathoms, sand. Station 149B, Kerguelen Island, 25 fathoms, volcanic mud.

(4) *Salicornaria divaricata*, n. sp. (woodcut fig. 8).

Character.—Zoarium slender, growth divaricate, 1 to 2 inches high; articulations nodular. Areas hexagonal, elongate; surface smooth or very faintly granular; interior ridges elevated, not united below nor above. Orifice crescentic, with a prominent lower lip. Operculum crescentic, rounded above, with strongly bordered angular apparent foramina 0″·004 × ·0025. Avicularia vicarious; mandibles spear-shaped, pointed, sometimes acicular, 0″·008 × ·005.

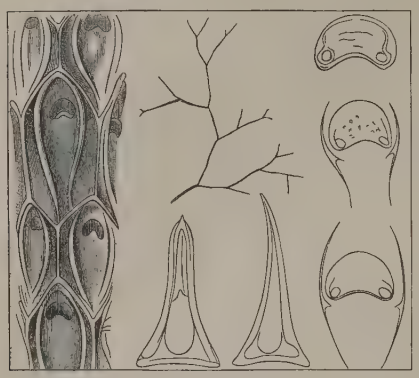


Fig. 8.—*Salicornaria divaricata.*

Habitat.—Station 163A, off Twofold Bay, 150 fathoms, green mud.

[Port Philip, Wilson.]

I had not recognised the distinction of this species in time to insert a figure in the plate and have therefore introduced it in the accompanying woodcut. It is distinguished readily enough by its general habit when good specimens are available. The operculum is comparatively small, and the avicularian mandible is in some cases acicular, in others more lanceolate. It belongs to the same class of mandibles as those of *Salicornaria malvinensis* and *Salicornaria dubia.*

(5) *Salicornaria bicornis*, Busk (Pl. XXXIII. fig. 9).

Salicornaria tenuirostris, var. a. *bicornis*, Brit. Mus. Cat., vol. i. p. 17, pl. lxiii. fig. 4.
(?) *Cellaria tenuirostris*, Macgilliv., Nat. Hist. Vict., Dec. v., p. 49, pl. xlix. fig. 3*c*.

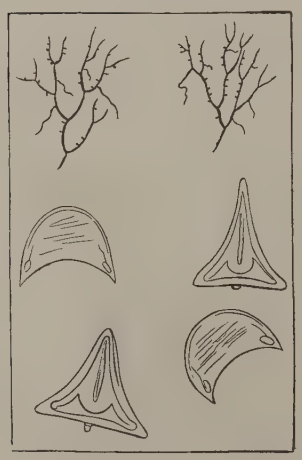


Fig. 9.—*Salicornaria bicornis.*

Character.—Zoarium 1 to 2 inches high, slender, dichotomous; internodes curved; joints nodular; numerous clasping filaments arising from the front of the zoœcia. Areas hexagonal; surface smooth; lateral ridges strongly developed and usually terminating above in a projecting angle. Orifice crescentic; lower lip very prominent in the middle, with a depression below it. Operculum crescentic, with the lower angles produced, acute, 0″·0045 × ·003 Avicularia intercalated ?, with a projecting rostrum above and a triangular mandible, 0″·0055 × ·0055 with an acute incurved apex and short median columella.

Habitat.—Station 163A, off Twofold Bay, 150 fathoms, green mud.

[Bass Strait, 45 fathoms, Voy. of Rattles.; Tasmania, Hooker.]

(6) *Salicornaria dubia*, n. sp. (Pl. XII. fig. 2).

Character.—Zoarium from 1 to 2 inches high, slender, dichotomous, divaricate; internodes pretty equal; joints nodular. Areas hexagonal; interior ridges strong, meeting above and below so as to circumscribe an oval space; surface granular. Orifice subcrescentic. Operculum subcrescentic or semicircular, 0″·006 × ·0035–·0040. Avicularia vicarious; mandible spear-shaped, with an incurved acuminate point, 0″·010 × ·006.

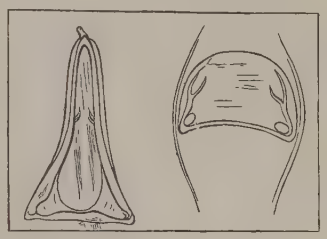


Fig. 10.—*Salicornaria dubia.*

Habitat.—Station 320, lat. 37° 17′ S., long. 53° 52′ W., 600 fathoms, green sand.

Allied to *Salicornaria malvinensis* in the characters of the avicularian mandible, but differing in the uniformly granular surface and the strongly developed interior ridges on the front. The operculum also is more strictly semicircular, instead of sub-elliptical as in *Salicornaria malvinensis*, and the chitinous lateral supports in the operculum are furcate, and not continued across as in *Salicornaria malvinensis*. The mandible also is smaller and slenderer. It might probably, however, be regarded as a variety of this species.

(7) *Salicornaria malvinensis*, Busk (Pl. XII. figs. 1, 5, 7).

Salicornaria malvinensis, Bk., Brit. Mus. Cat., vol. i. p. 18, pl. lxiii. figs. 1, 2.
Cellaria malvinensis, Waters, Bryoz. S. W. Victoria, Quart. Journ. Geol. Soc., August 1881, p. 321, pl. xiv. fig. 3.

Character.—Zoarium dichotomous, 2 to 3 inches high, composed of unequal internodes, sometimes much elongated, sometimes short and thick; joints nodular. Areas hexagonal

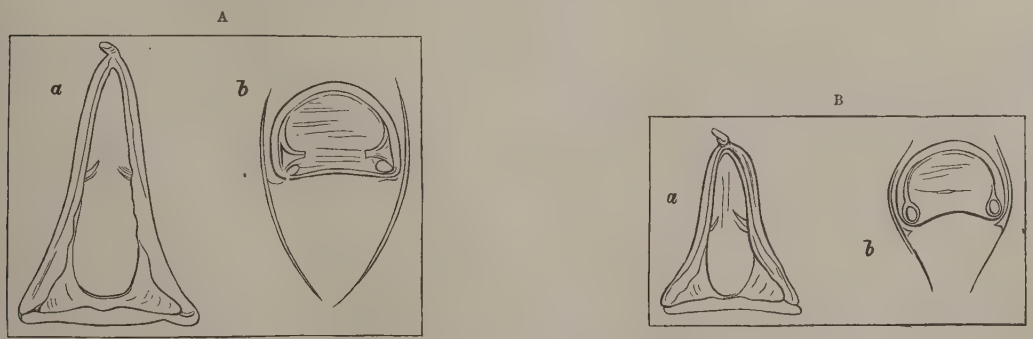


Fig. 11.—*Salicornaria malvinensis.* (Two varieties). A, Larger form; B, smaller form.

or pyriform when young; surface smooth, no interior ridges. Orifice crescentic, transversely elongate. Operculum semicircular or subcrescentic, angular, apparent foramina

small. Avicularia vicarious; mandible spear-shaped, with a very wide base and large inferior foramen; apex acuminate, incurved, 0″·013 × ·008 to 0″·0095 × ·008.

Habitat.—Station 149D, Royal Sound, Kerguelen, 28 fathoms. Off Marion Island, 50 to 75 fathoms. Station 304, lat. 46° 53′ S., long. 75° 12′ W., 45 fathoms, green sand. Station 315, lat. 51° 40′ S., long. 57° 50′ W., 12 fathoms, sand and gravel. Station 176, lat. 18° 30′ S., long. 173° 52′ E., 1450 fathoms, Globigerina ooze. Port William, Falkland Islands; 5 to 10 fathoms.

[South Patagonia, Falkland Isles, Strait of Magellan, Darwin; Mount Gambier (fossil), Waters.]

Salicornaria malvinensis presents considerable diversity of habit in different localities, so much so, that at first I had designated one of its varieties, characterised by the shortness and thickness of the internodes and the comparatively large size of the orifice, *Salicornaria megastoma;* but further examination has shown no essential differential characters between this and the forms with elongated and slenderer internodes. In the variety from Station 315 (fig. 7) a further exception to the more usual character is seen in the granular surface of the interareolar septa, when the epitheca has been removed.

(8) *Salicornaria tenuirostris,* Busk.

Salicornaria tenuirostris, Bk., Brit. Mus. Cat., vol. i. p. 17, pl. lxiii. fig. 3.
Cellaria tenuirostris, Smitt, Florid. Bryoz., vol. ii. p. 4 pl. i. figs. 57–59.

Character.—Zoarium slender, small, dichotomous; joints nodular. Areas hexagonal, distant; interior ridges united below; surface subgranular. Orifice nearly central, crescentic or semicircular. Operculum semicircular, lower border nearly straight, 0″·005 × ·003. Avicularia vicarious; mandible spear-shaped, 0″·009 × ·005, attenuated upwards, with a central columella and acuminate point.

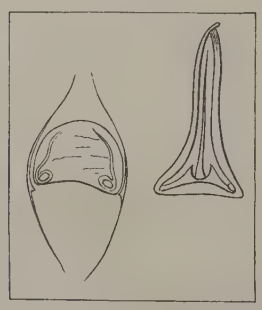


Fig. 12.—*Salicornaria tenuirostris.*

Habitat.—Station 314, lat. 51° 35′ S., long. 65° 49′ W., 70 fathoms, sand.

[Bass Strait, Voy. of Rattles.; Gulf of Florida, 58 to 60 fathoms, Smitt; Queenscliff, Victoria, Müller; Port Philip, Wilson.]

The mandible in *Salicornaria tenuirostris* is sometimes smaller and shorter, when it is scarcely distinguishable from that of *Salicornaria bicornis,* with which the species appears to be closely related. But the operculum differs considerably, and by this alone the two may be distinguished. The lateral trabeculæ, also, in *Salicornaria tenuirostris* are much longer than in *Salicornaria bicornis.*

(9) *Salicornaria gracilis*, Busk.

Salicornaria gracilis, Bk., Brit. Mus. Cat., vol. i. p. 17, pl. lxiii. fig. 3.
Salicornaria punctata, Bk., Voy. of Rattles., vol. i. p. 366.
Cellaria gracilis, Macgilliv., Nat. Hist. Vict., Dec. v., p. 50, pl. xlix. fig. 4.
(?) „ *attenuata*, d'Orb.
(?) „ *tenella*, Lamk.
(?) „ *salicornioides*, Savigny, Egypte, pl. vi. fig. 7.

Character.—Zoarium slender, small; joints nodular, dichotomous. Areas hexagonal; internal ridges prominent; surface granular. Orifice semicircular or subcrescentic. Operculum semicircular, sometimes with a crescentic granulated area, 0″·0035 × ·0025. Avicularian mandible large, semicircular, more or less angular above.

Habitat—Station 186, lat. 10° 30′ S., long. 142° 18′ E., 8 fathoms, coral mud.

[Off Cumberland Island, Cape Capricorn, Voy. of Rattles.; Queenscliff, Sealer's Cove, Müller.]

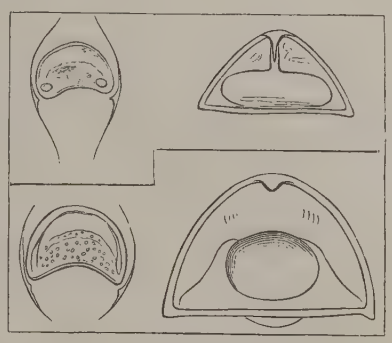


Fig. 13.—A, *Salicornaria gracilis*; B, *Salicornaria johnsoni*.

At one time I was inclined to regard *Salicornaria gracilis* as merely a variety of *Salicornaria johnsoni*, a species to which it bears, in some respects, a strong resemblance, and it would be difficult, from the external characters alone, to decide the question. Close re-examination, however, more especially of the chitinous parts, shows that the two are quite distinct. The accompanying figures will show the differences that exist in the opercula and mandibles of the two forms, whilst at the same time they will demonstrate how closely the corresponding parts represent each other. But there is another particular in which the specific diversity is plainly represented. In the Atlantic *Salicornaria johnsoni* the articulations are composed of straight tubes, as they are in *Salicornaria farciminoides*, *Salicornaria sinuosa*, and some others belonging to the northern hemisphere, whilst in the Australian form the joints are what I have termed "nodular,"—the more common mode as already observed in the southern species of the genus.

γ. inarticulatæ.

(10) *Salicornaria magnifica*, n. sp. (Pl. XII. figs. 4, 6).

Character.—Zoarium radicate, 1 or 2 inches high, continuous, branched on one side only, at very uniform distances, branches sometimes forked at the extremity, slightly compressed. Areas oblong or elongated hexagons, arched above, and from 0″·03 to ·05

long, by 0″·02 or ·025 wide; within the area a slight ridge,[1] forming a very obscure secondary area; surface nearly even. Orifice placed above the centre, semicircular, with a straight, entire, lower border. Operculum semicircular, 0″·008 × ·0055. Surface beneath the overlying epitheca finely granular. Avicularia, 0.

Habitat.—Station 323, lat. 35° 39′ S., long. 50° 47′ W., 1900 fathoms, blue mud. Station 122, lat. 9° 5′ S., long. 34° 50′ W., 350 fathoms, red mud. Station 157, lat. 53° 55′ S., long. 108° 35′ E., 1950 fathoms, Diatom ooze. Station 13, lat. 21° 38′ N., long. 44° 39′ W., 1900 fathoms, Globigerina ooze.

This beautiful species differs from all the other cylindrical *Salicornariæ*, in its being continuous and without the least trace of any articulation, notwithstanding the circumstance that it is rooted by radical fibres, and not by a calcareous base. In the apparently total absence also of any avicularian organs, it departs from all other *Salicornariæ*, at present known, as well as in the apparent want of any ovarian pores. It differs also in the arrangement of the oral chitinous armature, inasmuch as that the lateral trabeculæ are represented by a continuous ring, on which a slight projection on each side serves for the articulation of the operculum. In many respects the species appears to constitute a transition between *Salicornaria* and *Melicerita*.

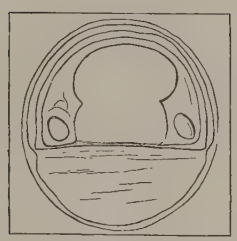


Fig. 14.—*Salicornaria magnifica.*

It is a form also of considerable interest with respect to its habitat. Of the four Stations at which it was procured, three belong to the Atlantic and one to the South Indian or Kerguelen region, and in three out of the four it came up from a depth of 1900 fathoms, and in the other probably from one of 400 fathoms. It may be regarded therefore distinctively as a deep-water form, and connected with this it will be as well to describe its common mode of attachment.

The disposition of the radicells in this case presents a curious peculiarity. The bundle of fibres constituting a rather long flexible stem is formed by separate tubules, which issue from the lower part of a certain number of the lowermost six or eight zoœcia. But the lowermost of these, or what might be termed the primary zoœcium, differs apparently in no respect from the rest. The growth may be said to start at once in its complete form. Immediately below this primary cell the tubes suddenly coalesce in an irregular manner, and at the same time become flattened out into broad ligulate bands which, after they have attained a length of an inch or more break up again into an inextricable tuft of filaments of the most unequal size, which ultimately terminate in irregularly beaded fibres. Thus there is formed a spongy mass, in the interstices of which all kinds of small bodies are entangled, such as *Globigerinæ* and other Foraminifera, sponge spicules, &c. But it should be noted that in more than one respect the radical

[1] Omitted in the figure.

tubes and fibres in this case differ from those of the deep water *Bicellariæ* and other abyssal forms, in the circumstance that they have a tendency to coalesce and form flattened bands as above stated, in something the same way as in *Kinetoskias*. And it should also be remarked that in the present case the ultimate fibrils are not individually affixed to separate particles, but rather by their interlacement form a soft spongy or felted mass, the interstices of which are filled and, as it were, weighted by the foreign substances contained in the meshes, or even, as sometimes may be seen, received into actual pouches formed by the flattened membranous bands.

The case affords a striking instance of the active organizing force inherent in the apparently amorphous chitinous substance of the radical tubes, which must be supposed, even down to the finest, to be lined by an active living tissue of some kind,—each segment in fact of every fibre being an actively living zooid as truly as are the zoœcia themselves.

§ 2. *compressæ*.

2. *Melicerita*, Milne-Edwards.

Melicerita, Milne-Edw., Ann. d. Sci. Nat., vol. vi. p. 26;
d'Orb. Reuss, Stoliczka, Busk, &c.
Melicertina, Ehrenb.
Ulidium, Searles Wood.
(?) *Latereschara*, d'Orb.
Cellaria (sp.); Waters.

Character.—Zoarium compressed, bilaminar, rigid, lobate, ligulate, or foliaceous; articulated or continuous. Zoœcia usually disposed in transverse rows.[1] Surface areolated. Area rhomboid or hexagonal. Orifice subcentral, semicircular, or oblong; border entire, with two articular teeth below and sometimes also above. Operculum corresponding in form to the orifice, supported by a chitinous ring, incomplete above.

In the conformation of the zoœcia and general structure of the zoarium there is no essential difference between *Melicerita* and *Salicornaria*, the two, as I have remarked in the "Crag Polyzoa" (p. 70), very closely corresponding. The main distinction between the two forms consists solely, as it would seem, in the compressed habit of the one and the cylindrical form of the other. The transverse arrangement of the cells and the absence of segmentation, if this be real, are perhaps characters insufficient of themselves to entitle *Melicerita* to the place of a distinct genus in the Family Salicornariadæ.[2]

[1] The disposition of the cells in transverse series is the main character upon which the genus was founded by M. Milne-Edwards, but it is not one that can be regarded as of primary importance, since the same disposition occasionally obtains in several species of *Salicornaria*, and notably in *Salicornaria malvinensis*, in some part or other of the zoarium.

[2] In a valuable paper on the Fossil Chilostomatous Bryozoa from South-West Victoria, Australia, published in the *Quarterly Journal of the Geological Society*, vol. xxxviii. p. 322, 1881, Mr. A. W. Waters observed that *Melicerita angustiloba*,

Up to the present time the only known species referrible to *Melicerita* were two, or perhaps three, fossil forms, viz. :—

1. *Melicerita charlesworthii*, Milne-Edwards.
2. *Melicerita angustiloba*, Busk.
(?) 3. *Melicerita* (*Latereschara*) *achates*, d'Orbigny.

Of these the first two are probably of Miocene age, belonging one to the Coralline Crag of England, and the second to beds, supposed to be of the same age, in Australia and New Zealand. M. d'Orbigny's species, if it be properly referred to the genus, belongs to the Cretaceous epoch. The discovery, therefore, of living forms at a considerable depth in the South Atlantic is one of very great interest, though they do not, so far as I can perceive, present any advance in organisation.

(1) *Melicerita atlantica*, n. sp. (Pl. XIV. fig. 1).

Character.—Zoarium simple or lobate, probably radicate; about 0″·25 wide. Areas hexagonal, usually arched above. Surface finely granular, sloping gradually and evenly to the orifice, which in the fresh state is surrounded at some distance by a slender chitinous ring incomplete above. Orifice large, central, suboval or oblong; lower border straight or slightly concave. Peristome thickened, with a minute internal denticle on each side below, none (?) above. Oœcial orifice a crescentic slit beneath the upper angle of the area. Avicularia 0.

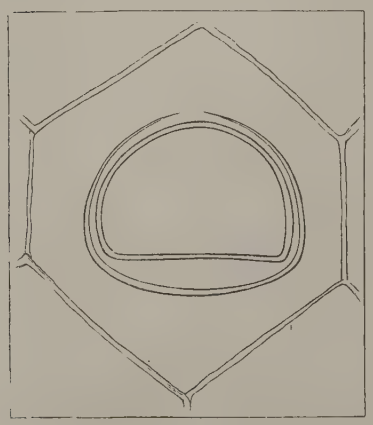


Fig. 15.—*Melicerita atlantica.*

Habitat.—Station 320, lat. 37° 17′ S., long. 53° 52′ W., 600 fathoms, hard ground.

In the narrow or ligulate form of the zoarium, *Melicerita atlantica* resembles *Melicerita angustiloba*, though it is somewhat broader. But in essential particulars the two differ very widely. In *Melicerita angustiloba* the lower border of the orifice is deeply notched on either side, or may be said to present a wide, straight-edged mucro. In it also, as in *Melicerita charlesworthii*, there are two large internal denticles above,

Bk., appears to be articulated, and that "it should be united with *Cellaria* (*Salicornaria*)," thus concurring in the view I had expressed. But it is by no means on account of the zoarium being articulated that this union should be made. It would be impossible to separate generically *Melicerita charlesworthii*, Milne-Edw., from *Melicerita angustiloba* and *Melicerita atlantica*, n. sp., the former of which is foliaceous and undoubtedly continuous, whilst the latter two may or may not be so The mere fact of articulation, therefore, is of little consequence, nor in fact is it so in the genus *Salicornaria* itself.

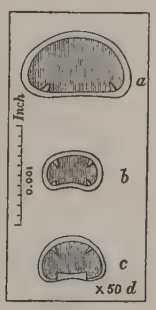
and probably also below, though the latter are either concealed by, or more probably coalescent with, the broad mucro. But in *Melicerita atlantica* the lower border of the orifice is quite even, without any appearance of a mucro, nor have I been able to detect any upper internal denticles, indeed I am not quite sure of their existence even below. If of small size they may, however, be concealed by the chitinous investment and operculum.

The relative dimensions of the zoœcial areas in the three species are as under:—

Melicerita charlesworthii, . . .	0″·015 × ·010
Melicerita angustiloba, ...	0″·022 × ·015
Melicerita atlantica, ...	0″·025 × ·035

and as the size of the areas in all three species appears to be remarkably uniform, these dimensions afford an additional differential character of considerable value. They also show that, so far as size is concerned, the recent form shows an advance upon its Miocene predecessors.

The accompanying figures show the relative proportion of the orifice in three species, drawn to scale and magnified about 50 diameters.



a. Melicerita atlantica.
b. Melicerita charlesworthii.
c. Melicerita angustiloba.

N.B.—As the only specimen of *Melicerita atlantica* is quite fragmentary, the account of its habit of growth is of course imperfect; nor is it possible to say how it is rooted, whether radicate or fixed, but most probably, like the rest of the Salicornariadæ, it is radicate.

(2)? *Melicerita dubia*, n. sp. (Pl. XXXIII. fig. 10).

Character.—Zoarium compressed, bilaminate, erect; composed of broad branching lobes of unequal width. Surface divided into uniform rhomboidal or hexagonal areas, angular at top and bottom, bounded by thick granular continuous ridges, and disposed in transverse series. Front much depressed, with a central rounded elliptical aperture, having a thick beaded or granular border, and the upper third occupied by a semicircular operculum; the lower part membranous. A few vicarious avicularia on the edges of the branches or lobes, with an obtuse mandible pointing upwards (fig. 10c).

Habitat.—Station 320, lat. 37° 17′ S., long. 53° 52′ W., 600 fathoms, green sand.

I have had great difficulty in assigning its family position to this very remarkable species, and it is with great hesitation that I place it with or next to *Melicerita* in that of the Salicornariadæ. The only other Family to which it might possibly be referred is

that of the Membraniporidæ, against which location, however, there seem to me to be very cogent reasons. In the first place, among the forty or fifty recent and other forms belonging to that Family, there is none, so far as I am aware, in which the cells are disposed in transverse series, nor any in which the surface is divided into angular areas by continuous ridges which apparently belong, as in all the Salicornariadæ, not to the individual zoœcia, but seem to form a continuous network within which the latter are contained. In the Salicornariadæ this continuous network is indicated, as before stated, by slender chitinous continuous hollow threads, and such may be contained within the thick calcified ridges in the present species, or may have been detached with the common epitheca by which they were originally clothed, but which in the single old and worn specimen afforded by the Challenger collection have become lost. Nor among the Membraniporidæ am I aware that any have a central aperture with a beaded and thickened border.

On the other hand, the chief, if not the only obvious, character in which any important divergence from the rest of the Salicornariadæ is exhibited, is the existence of an aperture larger than the true orifice.

All that is wanting to put the question of the Salicornarian affinities of the present species at rest, would be the existence of a chitinous ring or of lateral trabeculæ around or on the sides of the orifice. But whether such a provision existed in the superficial epitheca, or may be still contained in the thickened border of the aperture, I have not been able to make out. A remarkable peculiarity of *Melicerita dubia* is the extremely dense, hard, semi-transparent texture of the zoarium.

Family XV. Tubucellariadæ.

Cellaridæ (pars), d'Orb.
Salicornariidæ (pars), Macgilliv.
Porinidæ (pars), Hincks.

Character.—Zoarium erect; radicate, composed of cylindrical internodes. Zoœcia disposed round an imaginary axis, convex, distinct, pyriform; peristome produced, tubular. Surface reticulato-punctate or simply punctate with or without a simple median pore on the front (often wanting). Avicularia and oœcia 0.

The Family here contains the following genera:—

1. *Tubucellaria*, d'Orbigny.

(1) *Tubucellaria opuntioides*, Pallas (Pl. XXIV. fig. 7, and Pl. XXXVI. fig. 19).
(2) *Tubucellaria hirsuta*, Lamx. (Pl. XXXVI. fig. 18).

2. *Siphonicytara*, n. gen.

Siphonicytara serrulata, n. sp. (Pl. XV. fig. 2).

1. *Tubucellaria*, d'Orbigny.

Sertularia (pars), Gmelin.
Cellaria (pars), Solander, Lamx., Lamk., Blainv., Reuss, &c.
Cellularia (pars), Pallas.
Tubucellaria, d'Orb., Macgilliv.
Tubicellaria, Heller, Risso, Costa.
Onchopora (sp.), Busk.

Character.—Zoarium composed of cylindrical, usually quadriserial internodes, articulated by flexible tubular peduncles, and arising either dichomotously from the extremity, or irregularly from the sides of the segment from which they spring. Zoœcia pyriform, prolonged, and attenuated downwards, ventricose above and produced into a tubular peristome; bordered by a very thin septal ridge. A simple circular median pore (often absent) in front immediately below the tubular peristome. Surface reticulato-scrobiculate, or simply and sparingly punctate.

The genus *Tubucellaria* was instituted by M. d'Orbigny in 1851–2, for certain forms characterised pretty nearly as above, which had previously been included by himself and others under the vague names of *Cellularia* or *Cellaria*, and for some of which in 1855, not being aware of M. d'Orbigny's definition, I proposed the genus *Onchopora*, which, however, is now restricted to growths of a totally distinct kind. The only modification I have made in d'Orbigny's definition is to make it include more or less regular dichotomous groups; and the existence, at any rate in one division of the genus, of a median frontal pore and a peculiar reticulato-scrobiculate sculpture of the surface.

The genus thus defined would appear to include at least four known and well-marked forms, all of which are characterised by the peculiar sculpture of the surface above noticed, and usually by the presence of a simple circular median pore.

These species are:—

(1) *Tubucellaria opuntioides*, Pallas.
(2) *Tubucellaria cereoides*, Ellis and Solander.
(3) *Tubucellaria hirsuta*, Lamouroux.
(4) *Tubucellaria fusiformis*, d'Orbigny.

And to these it is probable that there may be added a fifth, in which the surface is simply and sparsely punctured and there is no trace of a median pore. To this form I would provisionally attach the name:

(5) *Tubucellaria cœca*, Busk.

Of these species, however, only two occur in the Challenger Collection.

(1) *Tubucellaria opuntioides*, Pallas (Pl. XXIV. fig. 7, and Pl. XXXVI. fig. 19, pars).

Cellularia opuntioides, Pallas, Elench., p. 61, 1766.
Sertularia opuntioides, Gmelin, 1789.
Cellaria cereoides (pars), Lamx., Lamk.
Tubucellaria opuntioides (pars), d'Orb.

Character.—Zoarium 1 to 2 inches high, forming tufted growths (*fruticuli inconditi*, Pallas); ramification irregular, sometimes ternate, rarely opposite; segments short or rather thick. Zoœcia distinct, pyriform, tapering above gradually into the tubular peristome, which curves gently forwards, slightly dilated towards the circular orifice, and grooved longitudinally, each groove containing a series of angular punctures; the intervening ridges finely beaded. Surface (calcined) reticulato-scrobiculate, the bottom of the pits being formed by a delicate centrally perforated calcareous diaphragm; interstitial ridges finely beaded. Operculum (Pl. XXXVI. fig. 19) in the form of a rounded oblong dish-cover, with the convexity outwards and a thickened border or rim. The opening measuring from 0″·006 to ·008 × 0″·003 to ·004.

Habitat.—St. Paul's Rocks, North Atlantic; shallow water.
John Adam's Bank, Voy. of H.M.S. "Herald."]

This well marked form agrees so perfectly with Pallas' admirably graphic description that I have no doubt of its being the species he intended, notwithstanding the difference of locality. Nor can there be any doubt of its distinction from the Mediterranean or may be also North Atlantic form described by Dr. Solander; nor again from a form which I have provisionally regarded as most probably that intended by d'Orbigny under the name "*fusiformis*," of which, if I am right, a fine specimen exists in the British Museum (No. 82, 2, 23, 410), from Thursday Island, Torres Strait, but of which I possess only one or two imperfect fragments from Australia or South Africa, but which suffice to show that the operculum is identical, or nearly so, with that of *Tubucellaria opuntioides*, from which facts we may consider the two to be closely related though differing widely in habit. The operculum also in *Tubucellaria cereoides*, it should be remarked, though of the same peculiar dish-cover-like conformation, is quite distinct.

(2) *Tubucellaria hirsuta*, Lamouroux (Pl. XXXVI. fig. 18).

Cellaria hirsuta, Lamx., Hist. des Polyp., p. 126, pl. ii. fig. 4, 1816.
Cellaria barbata, Lamk.
Cellaria and *Tubucellaria barbata*, d'Orb.
Onchopora hirsuta, Busk.
Tubucellaria hirsuta, Macgillivray, Decade v. p. 52, pl. xlix. fig. 6.

Character.—Zoarium 2 to 3 inches high, composed of tolerably uniform, short, thickish internodes articulated dichotomously. Zoœcia distinct, convex, slender, pyriform, much attenuated downwards, and above gradually tapering into the slender tubular

peristome, which is not grooved, or very obscurely so on the exterior, and not expanded at the orifice; surface reticulato-scrobiculate, the pits with a perforated diaphragm; interstitial ridges thin or even acute, finely beaded. On one or both sides of the front, on a level with the base of the peristome, a long, jointed chitino-calcareous spine articulated by a flexible joint over a circular opening; median pore rather large and often projecting. Operculum not cupped (?) semicircular 0″·007 × ·004–5.

Habitat.—Station 163A, off Twofold Bay, 150 fathoms, green mud.

[New Zealand, Darwin; Colenso; Queenscliff, Portland, Maplestone.]

Incineration shows that the lateral spines in *Tubucellaria hirsuta* are in reality of the nature of ordinary articulated oral spines, though at first sight they resemble radical tubes such as those which project from the front of the zoœcia in *Salicornaria hirsuta*.

2. *Siphonicytara*, n. gen.

Character.—Zoarium continuous, radicate, branched, branches alternate, subcylindrical quadriserial, subsecund. Zoœcia completely immersed below, flattened in front. Peristome tubular, extended. A circular median pore below the middle of the front. A large circular orifice (avicularian ?) near the top of most of the lateral zoœcia behind.

Siphonicytara serrulata, n. sp. (Pl. XV. fig. 2).

The only species.

Habitat.—Station 196, lat. 0° 48′ S., long., 126° 58′ E., 825 fathoms, hard ground.

As the only specimen of this very peculiar form is a small fragment, about 1 inch long, which had been placed by itself in a tube, I have been unwilling to injure it by too minute an examination, so that the internal structure has not been made out quite satisfactorily. I have, however, been able to ascertain one or two interesting particulars.

From the way in which the figures are shaded in the plate, it might be supposed that the lower part of each zoœcium in which the median pore is situated were convex and distinct from the upper part; but this is not really the case. The general surface of the branch, both before and behind, is in reality nearly even, though divided by fine raised lines or vibices, marking the outlines of the zoœcia, and also circumscribing a small area in which the median pore is placed.

The calcareous wall, beneath a strong brownish epitheca, is very thick and solid, and in the oral tube longitudinally fluted, as it is in *Tubucellaria cereoides*.

I have been unable to obtain a distinct view of the operculum, which, however, doubtless exists at the lower part of the tubular peristome.

The median pore, of small size, is circular and papilliform, and surmounted by a chitinous ring as in *Tubucellaria*.

On a transverse section, or rather fracture, of one of the branches the cavities of four zoœcia are exposed, varying of course in size according to the point at which the zoœcium has been broken across. As well as can be seen in such a rude mode of preparation, each zoœcial cavity appears to be divided into an anterior or superficial and a posterior or deeper chamber by a very delicate membranous septum. It would further seem that the posterior and somewhat larger of these chambers is the habitation of the polypide, and that into which the mouth opens, whilst the median pore appears to communicate with the anterior chamber through a very narrow passage. At any rate the dried remains of the polypide, with its vagino-parietal muscles, may be indistinctly discerned in the former; and in the latter, a brownish mass of uncertain nature.

On the dorsal aspect the surface is marked with the same delicate vibices as in front. Close behind the tubular portion of the lateral zoœcia is a large circular opening with a tumid border, and in one or two instances appearing to present a crescentic valvular fold, which may probably represent a modified avicularium; but this is very uncertain.

Towards the lower end of the zoarium, on the dorsal aspect, radical tubes may be seen, entering the backs of the zoœcia at uncertain points (fig. 2*b*). Though a very aberrant form, I do not see where this curious production can be more properly placed than near *Tubucellaria*, with which it appears to have closer affinities than with any other genus. The name is intended to indicate this connection.

Family XVI. Onchoporidæ.

Character.—Zoarium flexible, continuous, branched or lobate, ligulate or foliaceous, then unilaminar; zoœcia urceolate, ventricose. Orifice semicircular, with a straight entire lower lip. On the front, close below the orifice, a lunate fringed pore, and on each side an oblong or circular, perforated disc, with a raised border.

The above characters appear to me to be sufficient to separate the few species included in this small group from the numerous other forms possessing a very similar lunate pore, even when combined with a similarly shaped orifice, as in the genus *Microporella*. But considering, as Mr. Hincks truly remarks, that we do not know the physiological import of the lunate pore, and that the form of the mouth is common to a vast number of species, I am not at present inclined to agree with him in regarding these two characters, even in combination, as alone sufficient to justify the association of such otherwise very dissimilar forms as *Onchopora sinclairii* and *Onchoporella* (*Carbasea*) *bombycina*, Busk, &c., with the lepralian Microporellidæ.

The resemblance, however, between the zoœcial characters in *Onchopora bombycina*

and *Lepralia diadema* of Mr. Macgillivray is very striking, and such as would almost lead to the supposition that the species might be dimorphic. Mr. Macgillivray's species being characterised chiefly by its more highly calcified condition and adnate or decumbent habit, and, what is perhaps of more importance, the existence of several oral spines and of one or two avicularia on the front, appendages never seen in *Onchopora bombycina*.

The Family here contains the following genera:—

1. *Onchopora*, Busk.
   Onchopora sinclairii, Busk (Pl. X. fig. 4).
2. *Onchoporella*, n. gen.
   Onchoporella bombycina (Brit. Mus. Cat.)

1. *Onchopora*.

Onchopora (pars), Bk., Quart. Journ. Micr. Sci., vol. iii. p. 320.
Carbasea (pars), Bk., &c.
Malakosaria, Goldstein, Proc. Roy. Soc. Victoria, June 1881, p. 5, pl. ii. fig. 1.

Character.—Zoarium dichotomously branched, cylindrical, quadriserial.

Onchopora sinclairii, Busk (Pl. X. fig. 4).

Onchopora sinclairii, Bk., Quart. Journ. Micr. Sci., vol. v. p. 172, pl. xv. figs. 1, 2, 3.
Malakosaria pholaramphos, Goldstein, *loc. cit.*

Character.—Zoœcia ventricose, contracted below, usually (but not always) with an obtuse tubercle on each upper angle above the orifice. Lunate pore elongated from side to side, and above it two small round pores. Lateral fenestræ oblong, with two apparent perforations in each. Oœcium globose, prominent, subumbonate, with lines radiating from the centre.

Habitat.—Station 150, lat. 52° 4′ S., long. 71° 22′ E., 150 fathoms, coarse gravel. Station 151, off Heard Island, 75 fathoms, volcanic mud. Station 157, lat. 53° 55′ S., long. 108° 35′ E., 1950 fathoms, Diatom ooze. Station 149D, Royal Sound, Kerguelen, 28 fathoms, volcanic mud.

[New Zealand, Dr. Sinclair; Lyall; Australia, W. H. Harvey; Marion Islands, Voyage of Challenger, Goldstein]

The specimen from Station 157, 1950 fathoms, it should be observed, was in a much injured condition.

2. *Onchoporella*, n. gen.

Carbasea (pars), Gray.
Scruparia (pars), Busk.

Character.—Zoarium foliaceous, unilaminar, ligulate or lobed.

Onchoporella bombycina, Busk.

Carbasea bombycina, Bk. (*nec.* Solander, &c.), Brit. Mus. Cat., vol. i. p. 52, pl. xlviii. figs. 4–7.
Flustra bombycina, Linn., Syst. Nat., Ed. 13, 3828, No. 9.
„ „ Bosc, Vers 141; Lamx., Hist. des Polyp., p. 103, No. 196; Exp. Méth. p. 3, pl. iv. fig. B.
„ „ Lamarck (?); Krauss, Zooph. d. Südsee, p. 35.
Semiflustra bombycina (?), d'Orb.
(?) *Lepralia diadema*, Macgilliv.

Character.—Zoarium composed of narrow, ligulate, short lobes, expanding at the ends. Zoœcia pyriform, cylindrical, rounded in front. Lateral fenestræ with from one to four perforations in a vertical line. Oœcia prominent, with radiating lines.

Habitat.—Simon's Bay, Cape of Good Hope.[1]

Family XVII. Reteporidæ.

Reteporidæ, Smitt, 1867; Hincks, 1879.
Escharidæ (pars), d'Orb., 1851; Hincks, 1880; Smitt, 1872; Brit. Mus. Cat., 1852; Busk, Crag Polyz., 1859, Macgilliv., Auctt.

Character.—Zoarium calcareous, erect, fixed; foliaceous and fenestrate, unilaminar; or reticulately or freely ramose in one plane. Zoœcia secund.

The Family here contains the following genera :—

1. *Retepora*, Imperato.

§ α. *reticulatæ.*

(1) *Retepora apiculata*, n. sp. (Pl. XXV. fig. 6).
(2) *Retepora producta*, n. sp. (Pl. XXV. fig. 7).
(3) *Retepora denticulata*, n. sp. (Pl. XXVI. fig. 1).

§ β. *fenestratæ.*

§§ 1.[2]

(4) *Retepora imperati*, Busk, MS. (Pl. XXVI. fig. 9).
(5) *Retepora tessellata*, n. sp. (Pl. XXVII. fig. 8).
var. *a. cæspitosa* (Pl. XXVII. fig. 6).
var. *b. pubens* (Pl. XXVIII. fig. 3).

[1] *Scruparia diaphana*, Busk (*Quart. Journ. Micr. Soc.* [Zoophytology], vol. viii. p. 281, pl. xxxi. fig. 1, 1861) would form a secondspecies of *Onchoporella*.

[2] Under this section might perhaps be included the very interesting *Petralia undata* of Macgillivray as a sub-genus.

§§ 2.

(6) *Retepora gigantea*, n. sp. (Pl. XXVI. fig. 7).
(7) *Retepora lata*, n. sp. (Pl. XXVII. fig. 1).
(8) *Retepora crassa*, n. sp. (Pl. XXVII. fig. 3).
(9) *Retepora atlantica*, n. sp. (?) (Pl. XXVIII. fig. 1).

§§ 3.

(10) *Retepora victoriensis*, n. sp. (?) (Pl. XXVII. fig. 7).
var. (?) *japonica*.
(11) *Retepora simplex*, n. sp. (Pl. XXVIII. fig. 4).
(12) *Retepora hirsuta*, n. sp. (Pl. XXVI. fig. 4).
(13) *Retepora mucronata*, n. sp. (Pl. XXVI. fig. 6).
(14) *Retepora contortuplicata*, n. sp. (Pl. XXVI. fig. 2).
(15) *Retepora cavernosa*, n. sp. (Pl. XXVI. fig. 8).
(16) *Retepora tubulata*, n. sp. (Pl. XXVIII. fig. 2).
(17) *Retepora columnifera*, n. sp. (Pl. XXVI. fig. 5).
(18) *Retepora philippinensis*, n. sp. (Pl. XXVII. fig. 5).
(19) *Retepora phœnicea*, Busk.

§§ 4.

(20) *Retepora delicatula*, n. sp. (Pl. XXVI. fig. 3).
(21) *Retepora margaritacea*, n. sp. (Pl. XXVII. fig. 2).
(22) *Retepora jacksoniensis*, n. sp. (Pl. XXVII. fig. 4).
(23) *Retepora magellensis*, n. sp. (Pl. XXXVI. fig. 20).

2. *Reteporella*, n. sub-gen.

(1) *Reteporella flabellata*, n. sp. (Pl. XXV. fig. 5).
(2) *Reteporella myriozoides*, n. sp. (Pl. XXIV. fig. 2).

3. *Turritigera*, n. gen.

Turritigera stellata, n. sp. (Pl. XXIV. fig. 1).

1. *Retepora*, Imperato.

Retepora (pars), Lamk., Blainv., Johnst., Brit. Mus. Cat., &c.
Eschara (pars), Smitt.
Millepora (pars), Linn., Pallas, Ellis, &c.
Madrepora (sp.), Marsigli.

Character.—Zoarium reticulate, formed of flexuose anastomosing branches; or fenestrate; erect, springing with a calcareous stem, rarely from an incrusting or spreading base. Zoœcia disposed on one aspect only, usually deeply immersed, except on the sides

of the branches or trabeculæ. Primary orifice suborbicular or semicircular; border entire. Afterwards the peristome becomes much raised and multiform, usually fissured in the middle or one side in front, the fissure often becoming a suboral pore by the meeting of the upper angles. Very often a small avicularium on one of the angles which is also frequently developed into a labial or preoral rostrum. Usually numerous adventitious avicularia on one or both aspects of the zoarium.

The known recent species of which any intelligible descriptions have been given, so far as I have been able to ascertain, would appear to be twenty-five or thirty, several of which, however, will probably be found to be merely synonymous, for, as Mr. Hincks remarks, "it is essential that the diagnosis should be much fuller and more minute than authors have usually made it, and identification is not always sure." To which it may be added that up to the present time, one most essential point has been overlooked in all descriptions, viz., the character of the chitinous appendages, which in many cases will be found to afford the easiest and most certain means of diagnosis in this difficult and variable genus.[1] In the following account I have endeavoured to some extent to supply this deficiency, but time has not allowed me to do this so fully as I could have wished.

In his notes on the genus *Retepora*,[2] Mr. Hincks remarks that the notices by the older writers are valueless for purposes of identification, and the same remark applies to many of the descriptions of more modern date.

In the same paper he enumerates as all the recent species described up to that time —

1. *Retepora phœnicea*, Busk, = (?) *Retepora indica*, d'Orbigny.
2. ,, *monilifera*, Macgillivray.
3. ,, *porcellana*, Macgillivray.
4. ,, *granulata*, Macgillivray.
5. ,, *fissa*, Macgillivray.
6. ,, *versipalma*, de Blainville, = (?) *a Hornera*.
7. ,, *marsupiata*, Smitt, = *Retepora cellulosa*, var.
8. ,, *reticulata*, Pourtalès, = (?) *Retepora beaniana*, var.
9. ,, *wallichiana*, Busk and Hincks, = *Retepora elongata*, Smitt.
10. ,, *edwardsii*, = (?) *Retepora cellulosa*.
11. ,, *beaniana*, King.
12. ,, *cellulosa*, Auctt.
13. ,, *couchii*, Hincks.
14. ,, *prætenuis*, Hincks.

[1] Since this was written, Mr. P. H. Macgillivray, in a paper published in the *Proceedings of the Royal Society of Victoria*, August 9, 1883, which has but just come under my notice, has employed this means of diagnosis, and he observes that the chitinous parts are "very characteristic, and in fact it would be possible to identify most of the species by the examination of the *opercula* alone."

[2] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. i. p. 354, 1878.

15. *Retepora plana*, Hincks.
16. „ *tessellata*, Hincks.
17. „ *robusta*, Hincks, = (?) *Retepora porcellana*, Macgillivray.

To which may be added—

18. „ *bi-avicularia*, Smitt, = *Retepora beaniana*, var.
19. „ *altisulcata*, Ridley.
20. „ *microthyris*, Busk (MS.).
21. „ *umbonata*, Macgillivray (var. of *monilifera*).
22. „ *sinuata*, Macgillivray „ „
23. „ *lunata*, Macgillivray (?) „ „
24. „ *acutirostris*, Macgillivray (?) (var. of *monilifera*).
25. „ *munita*, Hincks (?) „ „
26. „ *formosa*, Macgillivray.
27. „ *carinata*, Macgillivray.
28. „ *serrata*, Macgillivray.
29. „ *aurantiaca*, Macgillivray.
30. „ *laxa*, Hincks (? var. *porcellana*, Macgillivray).
31. „ *avicularis*, Macgillivray.

To this list may be added, from the Challenger Collection, nearly as many more forms, thus raising the known, or approximately known, recent species of *Retepora* to between fifty and sixty. In view of this large number, it becomes almost imperative to subdivide the so-termed genus into sections, each having certain characters in common, and which in a monograph of the genus might perhaps come to be regarded as sub-genera, if such a term has any definite meaning.

With respect to the most convenient mode of arranging the various species, I quite agree with Mr. Hincks in regarding it "as more than doubtful whether the reticulated character of the zoarium is alone sufficient to supply the basis for a generic group." This is in fact abundantly clear from the circumstance that there are not only among the Cheilostomata fenestrate forms, such as *Adeona*, and one or two other Escharidans, but also among the Cyclostomata, as in *Retihornera*. I have therefore not hesitated to include in the same generic group species in which there is either no reticulation of any kind, or one of a different character from that which obtains in the great majority of species. But at the same time a transition, as it may be termed, can be observed from the freely ramified forms to those offering a true reticulation. For, in a certain number of species, the branches or trabeculæ, though lying mainly in one plane, are either quite free or irregularly interlaced, or united either by occasional direct anastomoses, or sometimes by non-celliferous transverse trabeculæ. In the latter case the general disposition of the trabeculæ or branches may be roughly likened to the tracery of Gothic windows of

what is called the "flamboyant" style. Consequently, in the following catalogue I have primarily grouped the species in three artificial, or perhaps natural, divisions or sections, distinguished respectively by their general habit or mode of ramification, though it should be understood that no very definite or abrupt limitation between them can be laid down.

§ *a. reticulatæ.*

Species in which the branches are connected so as to form a reticulate rather than fenestrate growth. Oœcia, when conspicuous, entire in front.

(1) *Retepora apiculata*, n. sp. (Pl. XXV. fig. 6).

Character.—Zoarium of considerable size, irregularly flexuose, much folded, expanding. Meshes extremely irregular in form and size, often traversed by barren trabeculæ. Zoœcia obscurely rhomboidal; primary orifice orbicular, with a wide secondary notch in front. Peristome rising on one side into one or two broad pointed teeth. Anterior avicularia prominent, rostriform, with an erect, acute beak; mandible narrow, lanceolate, acute, horizontal. Oœcia lofty, contracted and hollowed in front, inferiorly with a vertical median keel, and a depression on each side; anterior lip of the opening trifid. Dorsal surface coarsely granular, with a few irregularly dispersed depressed retentive avicularia, with a wide three-pointed mandible.

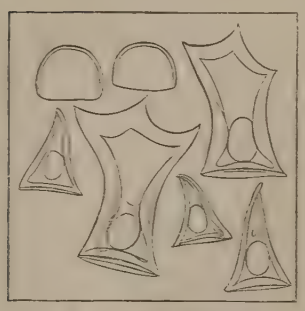


Fig. 16.—*Retepora apiculata.*

Habitat.—Station 172, Nukalofa, Tongatabu, 18 fathoms, coral mud.

(2) *Retepora producta*, n. sp. (Pl. XXV. fig. 7).

Character.—Zoarium rising from a rather broad base; expanding very irregularly in a hypocrateriform fashion, and very flexuose. Meshes elongated, narrow, acute at both ends, and of very irregular size. No barren transverse trabeculæ. Zoœcia urceolate, quite indistinct, orifice of the central ones deeply immersed, orbicular. Peristome level with the surface and unarmed, a rounded papillary eminence, usually on one side of the front. In the lateral zoœcia the peristome very much produced, subtubular, pectinate, each denticle supporting a delicate articulated spine. A very minute labial fissure, one angle of which frequently supports a minute avicularium, with a semi-circular mandible. Oœcia inconspicuous. Anterior avicularia very rare, with a long slender pointed mandible and usually a trifid beak (fig. 7*f*.). Dorsal surface (*c*) divided into irregular

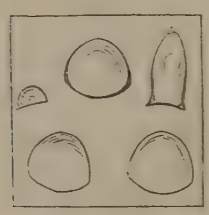


Fig. 17.—*Retepora producta.*

hexagonal areas, most of which present a rounded papillary eminence. Sometimes minute immersed avicularia within the meshes; none on any other part of the surface.

Habitat.—Station 172, Nukalofa, Tongatabu, 18 fathoms, coral mud. Samboangan, 10 fathoms.

[In the woodcut the anterior elongated mandible has been omitted.]

(3) *Retepora denticulata*, n. sp. (Pl. XXVI. fig. 1).

Character.—Zoarium expanded, flexuose, foliaceous, wavy, very irregular in form; composed of bifurcating, anastomosing branches, united very irregularly by transverse barren trabeculæ. Reticulation very unequal, meshes more or less rhomboidal, much elongated and narrow. Zoœcia rhomboidal or fusiform, flattened in front and deeply immersed. Orifice orbicular, notched in front, with a very minute avicularium on one side of the notch. Peristome, more especially in the lateral zoœcia, much produced, subtubular, slightly infundibuliform; usually with two acuminate conical teeth on each side; no spines. Oœcia inconspicuous. A few sparsely scattered large sessile avicularia placed on the front of the zoœcia; mandible spatulate, squarely truncate, pointing obliquely to one side; beak bifid. Dorsal surface finely granular, indistinctly areolated, shining; with deeply immersed avicularia, with blunt spatulate mandible, lodged within the lower angle of some of the fenestræ.

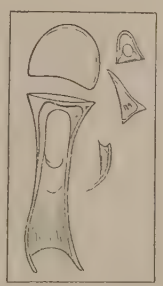


Fig. 13.—*Retepora denticulata.*

Habitat.—Off Honoruru, Sandwich Islands, 20 to 40 fathoms.

This species is distinguished from *Retepora producta* by the peristome in that species being much more produced, and its pectination limited usually to one side. In *Retepora denticulata* there are no marginal spines.

The three preceding species, which constitute the whole of the reticulate or flamboyant group, appear to be closely allied, but yet in minute characters they are quite distinct. As will be seen, they all belong to the Pacific regions.

§ *β. fenestratæ.*

Zoaria foliaceous, fenestrate.

§§ 1. Oœcia cucullate, closed, or more or less emarginate in front. Mouth orbicular, anterior border unarmed, simple or sinuate or subcanalicular (not fissured); no suboral pore. Operculum slightly produced below with a strong horse-shoe shaped rim. Dorsal avicularia numerous, usually placed within circumscribed areolæ, or tessellæ.

(4) *Retepora imperati*, Busk, M.S. (Pl. XXVI. fig. 9).

Retepora eschara marina, Imperato, 1559, p. 821.
Retepora cellulosa, α. (pars), Auctt.
Millepora foraminosa, Ell. and Soland., p. 138, pl. xxvi. fig. 2.
(?) *Retepora elongata*, d'Orb. and Smitt, var.

Character.—Zoarium of large size, repand, flexuose, widely infundibuliform. Fenestræ elongate, rhomboidal, narrow, about 0″·085 long. Dorsal surface of trabeculæ smooth and glistening. Zoœcia distinct, ovoid, separated by raised septa; anterior surface granular. Orifice suborbicular, slightly sinuated in front. Peristome thin, much raised on the sides, where it often forms a point. No labial fissure, or suboral pore, or oral avicularium. Oœcia very conspicuous, subcucullate (fig. 9*d*). Anterior avicularia sparse, and placed only on the older zoœcia, rostriform and projecting directly forwards; mandible long, acute, with the point curved forwards. Dorsal avicularia spear-shaped, numerous, irregularly distributed; one usually of larger size than the others at the lower angle of each fenestra. Operculum rounded oval, the muscular insertions on each side above the middle.

Habitat.—Station 75, lat. 38° 38′ N., long. 28° 28′ 30″ W., 450 fathoms, volcanic mud. Port Praya, St. Iago, Cape Verde Islands, 100 to 120 fathoms.

[Mediterranean, H.M.S. "Porcupine," M'Andrew].

It is a remarkable circumstance that, so far as I am aware, this very well marked and most conspicuous species should have hitherto, as it would seem, escaped distinct recognition, and the more so as it is probably abundant enough in the Mediterranean, forming, in fact, the bulk of the forms of *Retepora* collected on the voyage of the "Porcupine" in that sea, where, as is well known, three or four other species also occur, all of which have been often confounded under the common appellation of *Retepora cellulosa*.

But reference to the coarse, though sometimes very graphic, figures of the older writers, and especially to that contained in Imperato's work, will suffice to prove that in many, if not most cases, they have had the present form before their eyes.

It has, however, unfortunately happened that most later authors since Ellis have apparently only been acquainted with the two common northern forms, whose general similarity with that figured by Dr. Solander has led to their being confounded with it, although most have recognised a certain difference of habit, leading to the suspicion that the species might be distinct.

In the British Museum Catalogue (1852), the account of the species designated *Retepora cellulosa* was drawn up from specimens in Dr. Johnston's collection, amongst which it so happened that I noticed only the form so named, and another described by Mr. King as *Retepora beaniana*. The former may probably have been intended by Dr. Johnston, under the name of *Retepora reticulata*, but the reten-

tion of such an appellation for a species of a genus nearly all of whose members are in some sense reticulated seemed absurd, and I consequently retained the Linnean appellation. The minute characters assigned to it in the "Catalogue" having to a great extent been adopted by others, it may perhaps be advisable not now to change the appellation, but to retain it for that particular member of the Linnean genus, as has been done by Prof. Smitt. As regards the specific appellation here adopted, and which I have ventured to propose for the large Mediterranean *Retepora*, though Dr. Solander's name "*foraminosa*" might perhaps have been employed, the doing so would have involved a good deal of confusion with other forms, whilst the term itself is objectionable on the same grounds as that of "*reticulata*." In order, therefore, to prevent confusion becoming worse confounded, I have thought it convenient to employ a name which could give rise to no ambiguity, and at the same time include a recognition of the merit of the eminent naturalist who first described the species.

But another consideration also arises with regard to this form, which appears to me to render it doubtful whether, after all, the Mediterranean and Atlantic species here described may not be merely a variety of *Retepora elongata* of d'Orbigny and of Smitt, an arctic form for which at one time I proposed the name of *Retepora wallichiana*. The points of agreement, at any rate, between *Retepora elongata* and *Retepora imperati* are apparently of greater importance than those in which they differ. For instance, they both agree in the absence of fissure or stigma on the front of the oœcium, and in the want of any labial fissure or suboral pore, or any avicularian armature about the peristome, which in both though wavy is quite entire and much raised on the sides so as to become canaliculate in the older zoœcia, but is never thickened or fissured. The anterior rostriform avicularia are alike in both, though comparatively larger in the Mediterranean form. Both have the beak hooked like a parrot's and both have a very broad, lanceolate, or subtriangular curved-pointed mandible; and what is of great importance, the operculum in both is of the same peculiar conformation. In most species that I have had an opportunity of examining, the operculum is more or less semicircular or subcrescentic, consisting, in fact, mainly of a semicircular chitinous bow filled in by a thin membrane, the lower border being more or less simply membranous, whilst in *Retepora elongata* and *Retepora imperati*, as in the three succeeding species belonging to the same subsection, it is of a suborbicular or elliptical form, bordered all round, except for a small space at the bottom, by a thick chitinous ring, as shown in the accompanying figures in which (B) represents the operculum of *Retepora elongata* from Spitzbergen, and (A) that

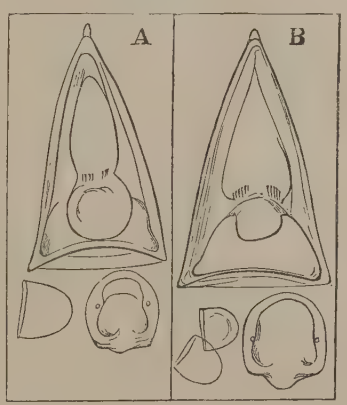


Fig. 19.
A, *R. imperati.*
B, *R. elongata.*

of *Retepora imperati* from the Mediterranean. The points of difference, as will be seen, between them are very slight. The operculum of *Retepora imperati* is smaller and the muscular insertions on the sides of the ring are above the middle, whilst in *Retepora elongata* they are below it. But these differences, trifling as they may seem, appear to be quite constant.

In the general form of the zoarium the aspect of the two differs considerably. The arctic form being altogether much more robust and the fenestræ of larger size and very unequal; in fact, in some instances specimens of *Retepora elongata* might be referred to the flamboyant or reticulate group, whilst in *Retepora imperati* the fenestræ are remarkably uniform in size and shape, and the whole growth is typically fenestrate. Notwithstanding the differences above noticed, and considering the wide interval of space in the habitats of the two forms, which would render variation extremely probable, I am much disposed to consider *Retepora imperati* as a variety of *Retepora elongata*.

(5) *Retepora tessellata* (Pl. XXVII. fig. 8).

Retepora tessellata, Hincks, Ann. and Mag. Nat. Hist., ser. 5, vol. i. p. 358, 1878, pl. xix. figs. 9–12; Macgilliv., Proc. Roy. Soc. Vict. 1883.

Character.—Zoarium large, intricately folded and contorted in a very irregular manner. Fenestræ oval or circular, small, tolerably uniform, but occasionally larger in parts of the zoarium. Zoœcia (young) urceolate, convex. Orifice semicircular, widely sinuated or notched (no fissure) in front. Peristome thick, with four large articulated spines (fig. 8*d*), two behind and one on each side. In the older zoœcia the orifice is deeply immersed and the two lateral spines only remain (fig. 8*b*). Surface generally very rugose and studded all over with minute avicularia with an acicular mandible; besides which, sparsely distributed, are large rostriform avicularia, with an acute lanceolate mandible with a very broad base (fig. 8*f*) and pointing downwards. Dorsal surface very rugose, often coarsely pitted and studded with innumerable small acicular avicularia, like those on the front. Oœcia deeply immersed, cucullate.

Habitat.—Simon's Bay, Cape of Good Hope.

The extraordinary way in which this species bristles with minute avicularia on both aspects is a very distinctive character. As only a few small fragments occur in the collection, no certain indication of the general habit of the zoarium is afforded. But a very good specimen exists in the Oxford Natural History Museum.

Var. *a*, *cæspitosa* (Pl. XXVII. fig. 6).

(?) *Retepora tessellata*, Hincks, Macgilliv.

Character.—Zoarium a globose tuft about 1″·5 in diameter, constituted of intricately contorted meandriniform folds; the oval fenestræ as wide as or wider than the trabeculæ; the dorsal surface uneven, no raised vibices, but instead a depressed line marking out distinct areolæ. Zoœcia very indistinct, surface glistening and uneven, or sometimes granular. Orifice orbicular, widely sinuated in front. Peristome even with the surface. Oœcia conspicuous, transparent, shining, smooth, very slightly depressed in front, without either fissure or stigma. Anterior avicularia rostriform, mandible triangular, acute, or like a shark's tooth, pointing forwards and downwards, or nearly horizontally; dorsal avicularia very irregularly distributed, crowded in some parts and absent in others; mandible triangular, pointed. Operculum horse-shoe shaped.

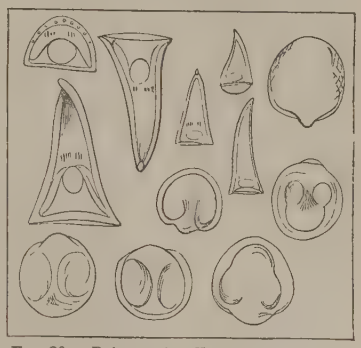


Fig. 20.—*Retepora tessellata* var. *cæspitosa*.

Habitat.—Simon's Bay, Cape of Good Hope.

Var. *b*. *pubens* (Pl. XXVIII. fig. 3).

Character.—Zoarium of very lax habit, composed of compressed branches, which anastomose very irregularly, forming wide irregular meshes, rather than fenestræ, of all sizes and of an elongated rhomboidal form. Zoœcia urceolate, flattened in front and usually presenting a large rostriform avicularium. Mouth orbicular, with a wide sinus in front, and sometimes in the younger cells a little notch on each side. Surface generally finely granular, the granulations having the form of minute cones. Dorsal surface areolated, showing the outlines of the zoœcia, but no raised vibices, and in the centre of each area is a minute immersed avicularium, besides which are numerous prominent small avicularia, with mandibles of the same form as those of the anterior rostriform ones. Oœcia unknown. Operculum horse-shoe shaped.

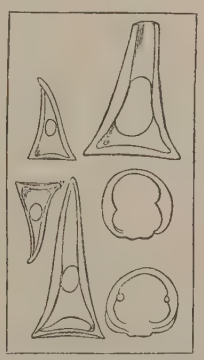


Fig. 21.—*Retepora tessellata* var. *pubens*.

Habitat.—Off Simon's Bay, Cape of Good Hope.

As this peculiar form is represented by only a single small fragment, covered with the acerose spicules of a sponge, which I at first mistook for a natural pubescence, the name was applied accordingly. Though not in the sense originally intended, the name is still to some extent justified by the beautiful granulation of the surface, the character of which is clearly shown in the fragments of the general epitheca

left in decalcified specimens. The great difference between the wide reticulation of this variety and the densely convoluted and minutely fenestrate habit of the variety I have termed "*cæspitosa*," is very remarkable, if the two in reality belong to one species, which there seems little room to doubt. But it is to be remarked that an equally great diversity of habit exists in the arctic *Retepora elongata* or *wallichiana*, some specimens of which are distinctly fenestrate, whilst others are as distinctly reticulato-ramose, whilst in *Retepora imperati*, which, as before observed, may be regarded perhaps merely as a variety of *Retepora elongata*, the mode of growth is always truly fenestrate. I would further remark that there is a form which I should regard also as a variety of *Retepora tessellata*, and of which the only specimen I am acquainted with is in the Oxford Museum, in which the zoarium, besides being bilaminar, is exactly like an *Eschara* (but fissile) throughout, except in a few spots here and there, where it presents the true Reteporine character, whilst the opercula and mandibles are exactly those of *Retepora tessellata* and its varieties. This form, which seems to be as yet undescribed, might be termed *Retepora escharoides*.

§§ 2. Oœcium with a vertical fissure in front.

(6) *Retepora gigantea*, n. sp. (Pl. XXVI. fig. 7).

Character.—Zoarium 2 to 3 inches wide, flabelliform, expanded, springing from a short thick stem. Fenestræ rhomboidal or broadly ovate, about 0″·1 long, and very uniform; trabeculæ nearly cylindrical. Zoœcia elongated, linear, quite immersed except the oral end, which forms a rounded pustulose elevation, in the centre of which is the sunken mouth. Anterior surface uneven, glistening; dorsal coarsely granular, very irregularly areolated, and presenting a few scattered circular pits. Orifice immersed, circular, with a shallow sulcus in front, on one side of which is frequently placed a small avicularium with a semicircular mandible pointing obliquely upwards. In many, more especially of the marginal zoœcia, the peristome rises into a blunt eminence or mucro. Oœcia deeply immersed, with a vertical fissure in front. Anterior avicularia (besides the oral) very rare, and of two kinds, one with an acute curved acuminate mandible pointing obliquely downwards and outwards (fig. 7, *b*.), and more rarely others of small size and oval form with a semicircular mandible (fig. 7, *c*.), and appearing like minute circular pits; in fact they resemble the dorsal pits, which, however, never appear to be furnished with any mandible. Operculum semicircular, 0″·006 × ·0045.

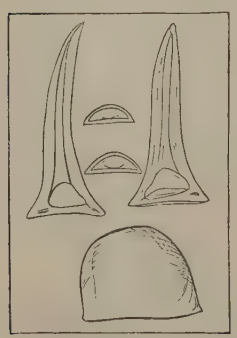


Fig. 22.—*Retepora gigantea.*

Habitat.—Station 148, lat. 46° 47′ S., long. 51° 37′ E., 210 to 500 fathoms, hard ground, gravel, shells.

This magnificent *Retepora* is at once distinguished by its gigantic proportions, which appear to be far greater than those of any other known species.

(7) *Retepora lata*, n. sp. (Pl. XXVII. fig. 1).

Character.—Zoarium expanded, folded, large and thick. Fenestræ very small, circular, distant, uniform. Dorsal surface granular, even, without apparent areolation. Zoœcia anterior wall thick, sparsely punctured, granular; in the older zoœcia verrucose. Outline oval or rounded. Mouth orbicular, in the older portions deeply immersed, with a very short labial fissure, soon reduced to a minute pore. Peristome even, very rarely a minute oral spine on one or both sides, more usually none. Oœcia erect, prominent, lofty, immersed at the base, usually with a vertical fissure in front. Anterior avicularia very rare, small, seated on raised papillæ; mandible triangular, pointed. No dorsal or fenestral avicularia.

Habitat.—Simon's Bay, Cape of Good Hope.

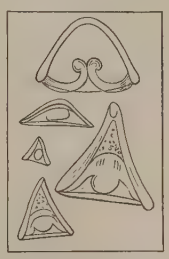


Fig. 23.—*Retepora lata.*

The striking character of this species is the comparatively minute size of the fenestræ in proportion to the width and thickness of the trabeculæ; and in accordance with this the number of zoœcia in the breadth of the branch is very great. Its remarkable operculum should also be noticed.

(8) *Retepora crassa*, n. sp. (Pl. XXVI. fig. 10; Pl. XXVII. fig. 3).

Character.—Zoarium of large size (several inches), irregularly foliaceous, expanded, elongated, rising from a very thick cylindrical peduncle. Fenestræ elongated, much narrower than the wide and thick trabeculæ, about 0″·1 long. Dorsal surface porcellanous, divided into small, irregularly hexagonal areolæ, in the centre of most of which is a prominent papilla, usually supporting a minute avicularium with a semicircular mandible. Zoœcia (young) urceolate, upper half prominent, free, but flattened in front. Orifice orbicular, sinuated. Peristome thin, raised, toothed, expanding, with two long slender unarticulated spines on each side (fig. 3*b*). Labial fissure median, short, wide, with an acute projecting angle on each side; suboral pore small. Oœcia deeply immersed, often open, sometimes closed by a membranous lid, vertically fissured (Pl. XXVI. fig. 10). Anterior avicularia very sparse and only on the older zoœcia, very small with a blunt gouge-shaped mandible, pointing directly downwards.

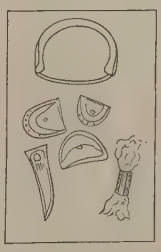


Fig. 24.—*Retepora crassa.*

Habitat.—Station 161, entrance to Port Phillip, 33 fathoms, sand. Station 162, off East Moncœur Island, Bass Strait, 38 fathoms, sand, shells.

This is a very remarkable form, from its size and peculiar mode of growth. The description of the zoœcia is taken from some at the growing edge, for in the older portions of the zoarium the characters are completely obscured by their crowded growth and deep immersion. The oral spines, though apparently not articulated, are very slender and fragile, and consequently are often wanting. The anterior avicularia are very small and inconspicuous, and may easily be overlooked. A great characteristic is the fine irregularly hexagonal areolation of the dorsal surface, and the existence of the minute umbonal avicularian papilla in nearly all the areolæ. The peculiar formation of the oœcia is also remarkable.

(9) *Retepora atlantica*, n. sp. (?) (Pl. XXVIII. fig. 1).

(?) *Retepora cellulosa*, var. *marsupiata*, Smitt, Florid. Bryoz., pl. xiii. figs. 245–254.

Character.—Zoarium an inch or more in diameter, infundibuliform or irregularly cupped, flexuose, white and pearly. Fenestræ oval, pretty uniform, not quite as wide as the trabeculæ. Zoœcia (young) subcylindrical, free above; surface smooth. Orifice suborbicular. Peristome slightly thickened, often a slender spine on each side towards the front, and sometimes, especially in the lateral zoœcia, rising on one side into three or four obtuse teeth. Labial fissure terminating in a round suboral pore; one angle thickened and prominent, supporting a small avicularium with a semicircular mandible. Oœcia deeply immersed, with a very short vertical fissure with converging sulci or rugæ. Anterior avicularia adventitious on the front of a zoœcium, varying much in size and sloping almost perpendicularly downwards. Mandible membranous, sword-shaped and apiculate. Dorsal surface smooth, vibicate, with elongated areolæ, and beset with numerous avicularia, seated chiefly on the sides of the fenestræ, with an elongated ensiform apiculate membranous mandible.

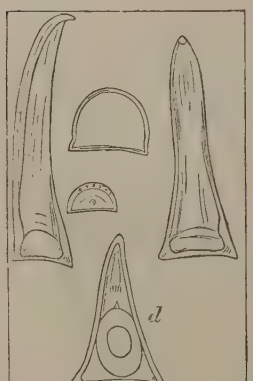


Fig. 25.—*Retepora atlantica.*

Habitat.—Station 75, lat. 38° 38′ N., long. 28° 28′ 30″ W., 450 fathoms, volcanic mud.

[(?) Gulf of Florida, Smitt; Tenerife, W. K. P.; Adriatic, Heller.]

This form so closely corresponds in many respects with Professor Smitt's species, that I am strongly inclined to think they may be the same. The operculum varies somewhat in size and form, and perhaps could scarcely be distinguished from that of *Retepora beaniana* or *Retepora cellulosa*.

But the avicularian mandibles are very peculiar, and sufficient to establish a distinction from those of any other species I have as yet examined. They are all of a very delicate membranous texture, with a small occlusor muscle inserted quite at the base, and having merely a very slight chitinous border at the lower part and no foramen. The avicularia, therefore, would seem to be of the "retentive" rather than the prehensile type, whilst in *Retepora cellulosa*, either from Spitzbergen or the Mediterranean, the avicularia are of the "prehensile" kind, and have the mandible adapted for forcible closure, and furnished with the usual long and powerful occlusor muscles, inserted high up, and with the usual foramen (woodcut 25, *d*). It should be noticed also that in *Retepora cellulosa* the rostriform avicularia stand horizontally out from the surface of the zoœcium, instead of sloping directly downwards as they do in *Retepora atlantica*.

§§ 3. Oœcium with a trifoliate stigma[1] in front.

(10) *Retepora victoriensis*, n. sp. ? (Pl. XXVII. fig. 7).

(?) *Retepora carinata*, Macgilliv.

Character.—Zoarium crateriform or widely infundibuliform. Fenestræ oval, distant, uniform; trabeculæ wide. Zoœcia (young) barrel-shaped or subcylindrical, wide at top; (older) flattened, subrhomboidal, parted by indistinct septal lines; wall smooth, entire, or very minutely and sparsely punctured. Peristome thin, usually raised in front or occasionally widely canalicular, with a short submedian fissure and small pore; one angle of the fissure often thickened and supporting a minute elongated avicularium. A long articulated and jointed spine on one, or sometimes on both, sides of the orifice and occasionally in the young zoœcia one or two slender non-articulated spines on the opposite side. Orifice (primary) in quite young zoœcia arched, with a straight entire lower lip, and sometimes a notch on either side. Oœcia large, prominent, strongly umbonate in front, and beneath the umbo an obscure trifoliate stigma. Anterior avicularia of several kinds; one of large size on low tubercular circular elevations, with a semi-

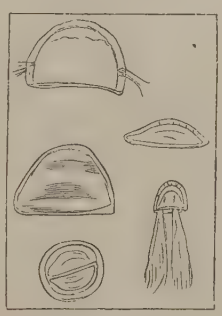


Fig. 26.—*Retepora victoriensis.*

[1] This very peculiar mark on the front of the oœcium, probably indicating the way of exit of the mature embryo, though noticed by Mr. Macgillivray more than twenty years ago, does not appear to have attracted subsequent attention, except in one instance, where Mr. Hincks in redescribing *Retepora monilifera* (1878) adverts to it "as a granulated rim above the upper edge of the aperture, from the centre of which a somewhat clavate band, also granulated or beaded, extends upwards almost to the top of the ovicell." Though forming the foundation of Mr. Macgillivray's name, it will be seen that this mark is by no means confined to that species, but may rather be regarded as more especially characteristic of the Australian *Reteporæ*, amongst which I am not aware that more than one (*Retepora fissa* (?)=*Retepora cellulosa*, Macgillivray) has hitherto been known with a vertical fissure. The Challenger Collection, out of nearly thirty species, affords a second instance (*Retepora crassa*), certainly distinct from Mr. Macgillivray's, whilst the same collection affords at least thirteen furnished with the trifoliate stigma.

circular mandible; another much smaller, boat-shaped; and a third of an oval form and of various dimensions. Dorsal surface granular, shining, vibicate, often with small circular deeply imbedded avicularia.

Habitat.—Station 161, off Port Philip, 33 fathoms, sand.

(?) Var. *japonica.*

Character.—Of much more delicate habit, the walls of the zoœcia being thin, delicate, and transparent. The peristome very thin, and more constantly produced into a wide spout.

Habitat.—Cobie, Japan, 8 to 50 fathoms.

[North Japan, Captain St. John.]

Notwithstanding a considerable difference in habit, as these two forms agree in many essential particulars, I have with some hesitation provisionally regarded them merely as varieties. The Japanese form is much more delicate in all respects, and the anterior avicularia, though of the same form as in the other and distributed in the same manner, are much smaller. The oœcia also appear much more numerous, and they present the peculiarity of remaining entirely open in front, apparently for a long time, as very few if any can be seen closed in. One character of the species which may facilitate its diagnosis is the great number of zoœcia in the width of the trabeculæ, and the frequently very regular way in which they are disposed in oblique, transverse rows. The operculum also in *Retepora victoriensis* is thick, and in var. *japonica* very delicate.

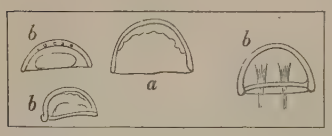


Fig. 27.—*Retepora victoriensis* var. *japonica.*

(11) *Retepora simplex*, n. sp. (Pl. XXVIII. fig. 4).

Character.—Zoarium, about 1″·25 high, irregularly infundibuliform, rising from a broad base; fenestræ oval, usually with a projection on one side, about 0″·025 × ·015 and of about the same width as the trabeculæ. Dorsal surface finely granular, no distinct vibices. Zoœcia convex, broad and short, ovate, surface subrugose. Orifice orbicular, peristome thin, deficient posteriorly. Labial fissure nearly median, very short and terminating in a rather large pore. A minute labial avicularium with semicircular mandible (often absent) on one of the angles of the fissure. A few scattered prehensile avicularia (readily overlooked) on the front and a few elongated retentive ones behind or in the fenestræ. Oœcia lofty, with a trifoliate stigma (fig. 4*b*), often widely open.

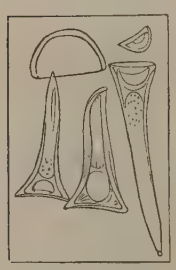


Fig. 28.—*Retepora simplex.*

Habitat.—Samboangan, 10 fathoms. Admiralty Islands.

This form appears to be closely allied to *Retepora contortuplicata* and *Retepora cavernosa*.

(12) *Retepora hirsuta*, n. sp. (Pl. XXVI. fig. 4).

(?) *Retepora monilifera*, Macgilliv., Hincks.

Character.—Zoarium of large size, irregularly folded or crateriform, without any distinct peduncle. Fenestræ small, oval, uniform, and fringed, as it were, with the oral spines or cilia. Zoœcia in the older portions quite immersed; when young subcylindrical, with a glistening surface. Orifice suborbicular or triangular, with rounded angles. Peristome raised in front and on the sides; a short sublateral labial fissure, which is merged more or less completely into a very large round suboral pore nearly as large as the orifice. Usually five long clavate antenniform oral spines (often absent), except in the marginal zoœcia. Oœcia conspicuous, with a trifoliate stigma. Anterior avicularia with a long delicate acuminate mandible (fig. 4*d*.) pointing transversely, and a bifid beak. Similar dorsal or rather fenestral avicularia. Besides these, on every lateral zoœcium, a minute conical avicularium (fig. 4*c*.) which projects into the fenestra, and has a bifid beak and a sharp pointed retentive mandible. Dorsal surface smooth and polished, indistinctly areolated.

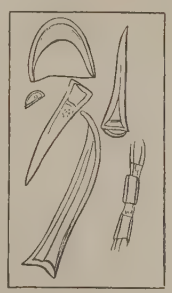


Fig. 29.—*Retepora hirsuta.*

Habitat.—Station 186, off Cape York, lat. 10° 30′ S., long. 142° 18′ E., 8 fathoms, coral mud.

Mr. Hincks (Ann. Nat. Hist. May 1878, p. 360, Pl. XIX. figs. 1–5), in describing Mr. Macgillivray's *Retepora monilifera*, remarks upon the great diversities in the habit of growth, and the remarkable variety of avicularian appendages which it exhibits. And Mr. Macgillivray (Proc. Roy. Soc. Vict., part. v. p. 4), notices several forms which he regards as varieties; and in my own collection I have several specimens doubtfully referrible to apparently the same generic type. In the Challenger Collection the only one referrible to this type is that above named, but to which, if any, of Mr. Hincks' or Macgillivray's supposed varieties I am quite unable to determine from the published descriptions or figures. To judge from Mr. Macgillivray's figures of the chitinous parts, it is, however, pretty certain that *Retepora hirsuta* does not represent either his typical *Retepora monilifera* nor any of its varieties as there depicted. Nor in the absence of the evidence afforded by those parts can it be determined whether it is the *Retepora monilifera* of Mr. Hincks or either of the varieties he alludes to. The trifoliate fissure on the oœcium and the moniliform or antenniform oral spines are common to several other quite distinct forms. So far as my observation extends I believe,

however, that the peculiar conformation of the operculum, and other chitinous parts, will be found characteristic in what might be termed the whole moniliferous group.

(13) *Retepora mucronata*, n. sp. (Pl. XXVI. fig. 6).

Character.—Zoarium probably much folded and irregularly contorted. Fenestræ broad, oval, about 0″·02 long, tolerably uniform. Zoœcia subrhomboidal in outline, completely immersed; anterior wall very thick, smooth and porcellanous; dorsal surface finely granular, with very distinct vibices and numerous small scattered immersed avicularia. Orifice orbicular. Peristome not raised, thickish, with a very minute labial sublateral fissure and pore; the lower or anterior lip on one side, often projecting into a pyramidal mucro or spout (fig. 6*c*). Oœcia subimmersed, depressed, with a small pore near the summit in front of a large trifoliate perforated stigma (fig. 6*d*). Anterior avicularia very rare, with a long spear-shaped mandible (fig. 6*e*), or sometimes with a blunt nearly semicircular one, like those on the dorsal surface.

Habitat.—Station 208, lat. 11° 37′ N., long. 123° 31′ E., 18 fathoms, blue mud.

A striking characteristic of this species is the peculiar translucent, thick, porcellanous nature of the zoœcial wall, and the production of the peristome in the older cells into a strong short mucro (in the younger it more usually assumes the form of a short spout), and the very minute labial fissure and pore, which in fact are only visible in the youngest zoœcia.

It is represented in the collection only by two or three small dead fragments, so that the general habit and chitinous parts cannot be determined.

(14) *Retepora contortuplicata*, n. sp. (Pl. XXVI. fig. 2).

Character.—Zoarium foliaceous, much and intricately folded, the folds frequently anastomosing (fig. 2*a*). Fenestræ oval, elongated, about 0″·02 long, very uniform. Zoœcia wholly immersed, those in the middle of the branches flattened or concave in front. Surface smooth, entire, bordered by an acute raised septal line. Dorsal surface smooth, with well-marked but thin vibices. Orifice orbicular. Peristome rather thick, with a sublateral fissure, shortly terminating in a suboral pore; a single oral spine on either side. Oœcia small, conical, acuminate, with a narrow trifoliate stigma. Anterior avicularia rare, placed on a small tubercular elevation, rather to one side of the front, close to the suboral pore. Mandible triangular,

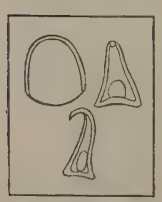


Fig. 30.—*Retepora contortuplicata.*

sometimes more acuminate and curved, pointing obliquely upwards and outwards (fig. 2b). No dorsal avicularia.

Habitat.—Off Honoruru, Sandwich Islands, 20 to 40 fathoms.

The specimens of this well-marked species in the Challenger Collection are very numerous, but unfortunately only in fragments of various sizes, some of which measure 2 to 3 inches across. The specimen figured, of the natural size, is one that has been long in my collection. Mr. Hincks appears to have contemplated giving the same name to a variety of *Retepora monilifera*.[1]

(15) *Retepora cavernosa*, n. sp. (Pl. XXVI. fig. 8).

Character.—Zoarium intricately contorted, the folds forming numerous anastomoses, so as to constitute a collection of tubular cavities about 0″·25 in diameter. Fenestræ very minute, circular or suboval, uniform. Zoœcia with very thick walls, deeply immersed and irregularly disposed. Orifice immersed, with a thick tumid peristome. Labial fissure nearly median, very short, forming, in fact, merely a small labial pore, the peristome being thickened on each side of it. Outline of zoœcia very obscure, but apparently rhomboidal. Oœcia tumid, convex in front, with a wide, trifoliate, perforated stigma; the anterior border of its orifice straight (fig. 8*d*). Anterior avicularia very rare, of an oval form, slightly elevated; mandible short, spear-shaped, acute, pointing obliquely downwards. No dorsal or fenestral avicularia.

Fig. 31.—*Retepora cavernosa.*

Habitat.—Station 148, lat. 46° 47′ S., long. 51° 37′ E., 210 to 500 fathoms, hard ground, gravel, shells.

As this form is represented in the collection by only one or two fragmentary specimens, the habit and dimensions of the zoarium cannot be determined, but it is probable that the latter are considerable. In its intricately contorted growth *Retepora cavernosa* resembles *Retepora columnifera*, but in that species the alveoli formed by the anastomoses of the folds are for the most part infundibuliform, whilst in *Retepora cavernosa* they may be more correctly described as tubular.

(16) *Retepora tubulata*, n. sp. (Pl. XXVIII. fig. 2).

Character.—Zoarium springing from a narrow base, without a distinct peduncle; immediately becoming tubular and continuing to grow by throwing out short tubular alveoli, each of which soon expands into a wide infundibuliform dilatation. Fenestræ

[1] Ann. Nat. Hist., ser. 5, vol. i. p. 362, 1878.

oval, narrower than the trabeculæ. Zoœcia ovate or subrhomboidal, flattened in front; very distinct in the younger portions and separated by a thin septal ridge; walls very thin and transparent, surface smooth. Orifice suborbicular. Peristome thin and usually produced on the sides and in front into a spout-like projection, sinuated in the middle. Labial fissure small and apparent only in some zoœcia, being usually merged in the wide canalicular sinus. An angular ridge descends from the projecting lip and is lost on the flattened anterior surface of the zoœcium. A small avicularium, seated on a low eminence, is sometimes seen a little below and to one side of the orifice, with an obtuse, or sometimes acute, triangular mandible pointing laterally or in front. Dorsal avicularia small and sparse, resembling the anterior or semicircular ones. In some of the fenestræ are boat-shaped, retentive avicularia, with a double bifid beak, and furcate membranous mandible, very like those in *Retepora columnifera*. Oœcia of large size, subglobose, with a trifoliate stigma, the upper limb of which usually terminates in an acuminate tubercular point.

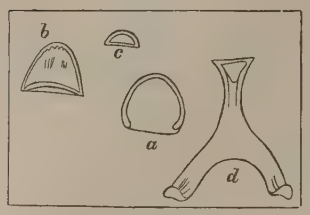


FIG. 32.—*Retepora tubulata.*

Habitat.—Station 186, off Cape York, lat. 10° 30′ S., long. 142° 18′ E., 8 fathoms, coral mud.

Differs from *Retepora philippinensis* (in which species the zoarium is also constituted of more or less tubular or trumpet-shaped, but much wider, alveoli) in having the celliferous surface, as usual, on the internal face of the alveoli. And besides this, *Retepora philippinensis* seems in all probability to be completely unarmed.

(17) *Retepora columnifera*, n. sp. (Pl. XXVI. fig. 5).

Character.—Zoarium 1 inch to 2 inches or more in height, composed of numerous, widely expanding, flexuose, infundibuliform alveoli; spreading over and affixed to foreign bodies, not by a common peduncular base, but by numerous solid or tubular calcareous columnar processes springing from the dorsal surface. Fenestræ oval, about the same width as the trabeculæ, and of very uniform size. Zoœcia two or three in the width of a trabecula, immersed and flattened in front; surface entire, smooth. Orifice orbicular, with a small shallow fissural notch in front, which in the youngest zoœcia sometimes presents a very minute avicularian tubercle on one angle. Generally, however, the peristome is thin, slightly

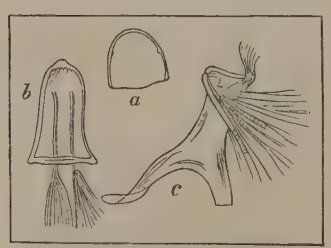


FIG. 33.—*Retepora columnifera.*
a, Operculum; *b*, Columnar avicularium; *c*, Fenestral avicularium.

raised and prominent in front. Oœcia rather large, globose, with a trifoliate stigma. Anterior adventitious avicularia very sparse, in the form of cylindrical, slightly curved, obliquely truncated columns, which spring from the front of a cell (fig. 5*c*), and have a blunt duck-bill shaped mandible. At the lower angle of many of the fenestræ retentive avicularia occur, in the form of a boat with a double prow (fig. 5*e*), each of the prows having a bifid beak, and each branch of the furcate, membranous mandible fits into one of the bifid beaks, the space between the branches of the fork being partially filled with a delicate membrane (fig. 5*d*).

Dorsal surface shining, finely granular or submuricate, with distant indistinct vibices, and a few immersed avicularia of the same conformation as the fenestral, but of very much smaller size.

Habitat.—Station 190, lat. 8° 56′ S., long. 136° 5′ E., 49 fathoms, green mud.

This species, which has several characters in common with *Retepora tubulata*, is, however, at once distinguished by its peculiar mode of attachment by means of solid columnar dorsal processes, which are doubtless homologous with the chitinous tubular processes, by which several *escharan* species of *Membranipora* and *Diachoris* are attached. The anterior columnar avicularia also form a conspicuous feature, altogether wanting in *Retepora tubulata*. These may, perhaps, be regarded as homologous with the columnar dorsal processes.

(18) *Retepora philippinensis*, n. sp. (Pl. XXVII. fig. 5).

Character.—Zoarium (in a single specimen) about 1 inch long, infundibuliform, with the sides pinched in. Fenestræ very small, circular, and very uniform in size. Celliferous surface external, dorsal (or non-celliferous) surface interior, smooth, dull. Zoœcia urceolate, distinct. Orifice orbicular. Peristome thick, deficient or slightly tuberculated behind, slightly raised in front and on the sides; sometimes subcanaliculate in front. Labial fissure, or rather sinus, rather wide and shallow. Oœcia conspicuous, acuminate in front, with a row of three or four punctures close to the border of the orifice (fig. 5*b*). Avicularia 0 (?)

Habitat.—Station 212, lat. 6° 54′ N., long. 122° 18′ E., 10 to 20 fathoms, sand.

As the only specimen is a small dead and imperfect fragment, the general habit and size of the zoarium and the characters of the chitinous parts cannot be stated, but it probably consists of a congeries of infundibuliform or trumpet-shaped alveoli. One peculiarity consists in the circumstance that, contrary to the usual arrangement, the celliferous surface is on the outside of the folds; and another peculiarity is the apparently complete absence of avicularia of any kind.

(19) *Retepora phœnicea*, Busk.

Retepora phœnicea, Bk., Brit. Mus. Cat., vol. i. p. 94, pl. cxxi. figs. 1, 2.

Character.—Zoarium folded, expanding, much convoluted; of a purple colour. Zoœcia ovate, ventricose. Orifice prominent, circular, sometimes subtubular. Border entire or irregularly serrate. Raised interzoœcial septal ridges. Anterior avicularia sparse, placed obliquely on the front, close below the orifice, with an acuminate mandible very wide at the base. Oœcia immersed (when young having in front a concentrically marked operculum).

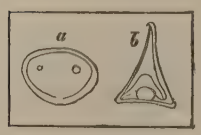


Fig. 34.—*Retepora phœnicea.*

Habitat.—Station 162, off East Moncœur Island, Bass Strait, 38 fathoms, sand, shells.

[South Australia, Adelaide, Glenelg, Hincks.]

I have placed *Retepora phœnicea* with the species furnished with a trifoliate stigma, considering that the stigma is represented by the sort of operculum with which its oœcium is at one time furnished, and which is probably of the same nature as the stigma.

§§ 4. Oœcia inconspicuous or unknown.

(20) *Retepora delicatula*, n. sp. (Pl. XXVI. fig. 3).

Character.—Zoarium about 0″·5 high, cup-shaped, springing from a central point, but without any actual peduncle. Fenestræ oval, uniform. Zoœcia broadly ovate. Orifice wide, orbicular. Peristome raised and canaliculate in front, expanding on the sides. Anterior lip with a lateral fissure, terminating in a large rounded pore. On one side of the fissure an extremely minute avicularium, on a small tubercular thickening of the angle. From 1 to 3 oral spines, sometimes obscurely jointed on each side. Oœcia inconspicuous. Anterior avicularia extremely rare; seated on short conical processes. Mandible triangular, obtuse, pointing forwards; dorsal or rather fenestral avicularia deeply immersed; the mandible, which is deeply sunk, is long, slender, and usually furcate, pointing directly downwards.

Fig. 35.—*Retepora delicatula.*

Habitat.—Station 190, lat. 8° 56′ S., long. 136° 5′ E., 45 fathoms, green mud.

The furcate fenestral avicularian mandible is something like that of *Retepora tubulata* and *Retepora columnifera*, but the limbs of the fork are wider, shorter, and pointed instead of being obliquely truncated. A special group might perhaps be made of the species having furcate retentive mandibles. There are several besides those in the Challenger Collection, and all probably Australian or New Zealand forms.

(21) *Retepora margaritacea*, n. sp. (Pl. XXVII. fig. 2).

Character.—Zoarium foliaceous, expanded. Fenestræ elliptical, irregular in size and form, about the same width as the trabeculæ. Dorsal surface finely verrucose, glistening, pearly. Zoœcia deeply immersed, outline imperceptible, surface warty. Orifice deeply immersed, elliptical from side to side; labial fissure sublateral, short and wide. Peristome slightly raised all round, posteriorly pectinate, with four or five obtuse teeth, upon which are articulated short slender pointed spines. Oœcia inconspicuous. Anterior avicularia in front of almost every zoœcium, on one side close below the labial fissure or pore; large and prominent, with a much curved slender acute mandible pointing horizontally to one side (fig. 2*a*); the edge of the avicularian cup serrated. Besides these, when the larger ones are absent, a minute avicularium on one side close below the suboral pore (fig. 2*b*). No dorsal avicularia.

Fig. 36.—*Retepora margaritacea.*

Habitat.—Station 176, lat. 18° 30′ S., long. 173° 52′ E., 1450 fathoms, Globigerina ooze.

Unfortunately only a single specimen of this interesting form was contained in the gathering at this Station. The width of the specimen is about 0″·75. It is convex on the anterior side, and to the naked eye is chiefly remarkable for the irregular size and disposition of the fenestræ. The verrucose, beautifully pearly, glistening surface is also distinctive, as well as the size and position of the anterior avicularia, and the form of the mandible, which is remarkable for its long curvature.

(22) *Retepora jacksoniensis*, n. sp. (Pl. XXVII. fig. 4).

Character.—Zoarium infundibuliform, flexuose. Fenestræ oval, narrow, pointed at each end, irregular in size. Zoœcia elongated, rhomboidal, flattened in front. Peristome much raised on the sides and the front, bifid or trifid on each side. Labial fissure wide and shallow, anterior surface smooth, with a strongly raised septal line. Dorsal surface wrinkled, with irregular wavy vibices. Oœcia inconspicuous. Anterior avicularia sparse, placed rather to one side of the upper part of the front; in the younger zoœcia almost level with the surface, mandible acute, pointing directly downwards; in the older zoœcia the avicularium forms a prominent central rostrum (fig. 4*b*), in which the mandible of the same shape, and not much larger, points directly forwards. No dorsal avicularia, but occasionally one like the anterior at the lower angle of a fenestra.

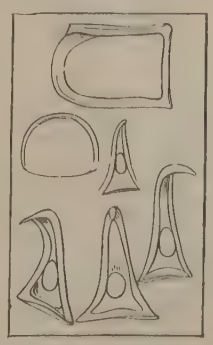


Fig. 37.—*Retepora jacksoniensis.*

Habitat.—Port Jackson, 2 to 10 fathoms, mud.

Among the chitinous parts in this species I have occasionally noticed one of the peculiar form shown at the top of the figure—the nature of which is obscure.

(23.) *Retepora magellensis*, n. sp. (Pl. XXXVI. fig. 20).

Character.—Zoarium infundibuliform or cupped, rising from a short thick peduncle. Fenestræ elongate oval, pointed at each end about 0″·1 × ·05, rather narrower than the trabeculæ. Surface both before and behind finely granular and glistening. No dorsal or fenestral avicularia and no vibices. Zoœcia elongate, ovate, convex, and distinct in the younger parts. Orifice contracted, primarily clithridiate, peristome, not thickened, with a short submedian fissure and small pore, and a labial avicularium on one angle; four to six slender oral spines visible only in the youngest cells. Operculum semicircular, with a thick rim, about 0″·012 × ·01, and often having two lemniscus-like sacculi dependent behind the lower border. Avicularian mandible, with very strong occlusor muscles, and an elongated lemniscus-like sacculus between them.

Habitat.—Station 320, 37° 17′ S., 53° 52′ W., 600 fathoms, green sand.

[Falkland Islands, Miss Gatty].

2. *Reteporella*, n. sub-gen.

Character.—Those of *Retepora*, but the branches free in one plane.

(1) *Reteporella flabellata*, n. sp. (Pl. XXV. fig. 5).

Character.—Zoarium flabellate, about 1″·5 high, and wide; composed of dichotomous branches, diverging from a thick common peduncle, attached to coral by a calcareous non-celliferous expansion. Zoœcia (young) ovate, convex; surface granular, glistening, pearly. Orifice orbicular. Peristome thick, annular, slightly raised; a rather long labial fissure terminating in a large pore. From one to three broad, flattened, lanceolate, antenniform, articulated spines on one or both sides. Anterior avicularia on tubercular eminences, seated on the lower part of most of the zoœcia; mandibles, very delicate, membranous. No dorsal avicularia. Dorsal surface, showing the outlines of the zoœcia, pearly, granular, not vibicate. Oœcia 0 (?)

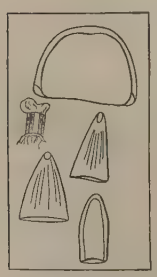


Fig. 38.—*Reteporella flabellata.*

Habitat.—Station 151, off Heard Island, 75 fathoms, volcanic mud.

Only a single specimen of this interesting form occurs in the collection. In the lower parts of the zoarium the surface is almost smooth and entire, nearly all traces of the individual zoœcia being completely obliterated.

(2) *Reteporella myriozoides*, n. sp. (Pl. XXIV. fig. 2).

Character.—Zoarium irregularly branched, for the most part in one plane; branches mostly opposite and forked at the ends (fig. 2*a*). Zoœcia (young) ovate, deeply immersed; surface closely pitted or punctate, puncta elongated. Orifice (primary), orbicular, with a wide sublateral fissure, and usually very deeply immersed. Secondary orifice orbicular, with a very thick annular peristome, usually mucronate, rather to one side in front; sometimes a small avicularium on the inner base of the mucro. Anterior avicularia rare, on very slight eminences on the front of a zoœcium; mandible obtuse, pointing downwards (fig. 2*c*). Dorsal surface pitted, without avicularia. Oœcia (?)

Habitat.—Station 148, lat. 46° 47′-53′ S., long. 51° 37′-52′ E., 210 to 500 fathoms, hard ground, gravel, shells.

This extremely aberrant form is very doubtfully referred to the Reteporidæ. In some respects it appears to resemble a *Myriozoum*, but the peculiar fissured orifice has induced me to place it with or near the former group.

Geographical Range of Retepora.

Two species occurred in the North Atlantic region—

Retepora imperati.
„ *atlantica.*

Five in the South Atlantic region—

Retepora tessellata.
var. *cæspitosa.*
var. *pubens.*
„ *lata.*
„ *magellensis.*

Four in the South Indian region—

Retepora gigantea.
„ *cavernosa.*
Reteporella flabellata.
„ *myriozoides.*

Eleven in the Australian region—

Retepora apiculata.
,, *producta.*
,, *crassa.*
,, *victoriensis.*
,, *hirsuta.*
,, *tubulata.*
,, *columnifera.*
,, *phœnicea.*
,, *delicatula.*
,, *margaritacea.*
,, *jacksoniensis.*

Five in the Philippine region—

Retepora producta.
,, *japonica.*
,, *simplex.*
,, *mucronata.*
,, *philippinensis.*

Two in the North Pacific region—

Retepora denticulata.
,, *contortuplicata.*

Bathymetrical Range.

As at many of the Stations the depth varies very considerably, and in some is not stated at all, it is impossible for most of the species to specify any definite depth. It would seem, however, that of the twenty-six species six must have lived at a less depth than 20 fathoms, viz :—

Retepora simplex.
,, *hirsuta.*
,, *mucronata.*
,, *tubulata.*
,, *philippinensis.*
,, *jacksoniensis.*

Six under 50 fathoms—

Retepora denticulata.
,, *victoriensis.*
var. *japonica*
,, *contortuplicata.*
,, *columnifera.*
,, *delicatula.*

Ten under 240 fathoms—

Retepora apiculata.
,, *producta.*
,, *crassa.*
,, *phœnicea.*
,, *tessellata.*
var. *cæspitosa.*
var. *pubens.*
,, *gigantea.*
,, *lata.*
Reteporella flabellata.

Five under 600 fathoms—

Retepora imperati.
,, *atlantica.*
,, *cavernosa.*
,, *magellensis.*
Reteporella myriozoides.

One at 1450 fathoms—

Retepora margaritacea.

On the whole, therefore, the Family, as represented in the Challenger Collection, would seem to belong for the most part to comparatively shallow depths, and the nature of the bottom appears to have been indifferent; in most cases it was mud of various origin (continental, coral or volcanic), in a few instances sand or gravel, and in one Globigerina ooze.

3. *Turritigera*, n. gen.

Character.—Zoarium ramose, arising from a calcareous expansion, encrusting foreign bodies, having the openings of the zoœcia usually on one side only. Zoœcia ventricose or flask-shaped, much produced and subtubular above, with several conical or columnar avicularian processes on the peristome.

Turritigera stellata, n. sp. (Pl. XXIV. fig. 1).

Character.—Zoarium composed of four or five short furcate branches, springing from a common peduncular centre, and forming a stelliform growth. A few scattered anterior avicularia (with a duck-bill shaped mandible pointing downwards). Dorsal surface finely rugose, studded with numerous minute papilliform eminences, supporting small avicularia.

Habitat.—Station 320, lat. 37° 17′ S., long. 53° 52′ W., 600 fathoms, green sand. Station 142, lat. 35° 4′ S., long. 18° 37′ E., 150 fathoms, green sand.

This very remarkable form appears to be more nearly allied to *Retepora* than to any other generic group, but the very curious conformation of the oral portion and aperture, and its other peculiarities, seem to justify its being considered as generically distinct.

The inflated, ventricose, or flask-shaped zoœcia, rise into a long and usually free tubular process, around whose opening spring several cylindrical columnar processes (fig. 1*b*), each supporting on its summit a small avicularium. But besides the columnar processes, there is always a larger one on the posterior side; of a conical form, and having its avicularium below the summit. The number of these avicularian processes increases with the age of the zoœcium. The first to make its appearance is the hinder conical one, then appears one on each side of a cylindrical form, then a third or fourth in front. The armature of the peristome, therefore, and especially the posterior conical process, is very similar to that of many Cellepores; and in the same connection it may be remarked that here and there may be noticed an adventitious zoœcium of smaller size, but otherwise of the same conformation as the others springing from the front of one of the older zoœcia.

Although, generally speaking, the zoarium shows the oral orifices only on one face, occasionally an opening may be seen on the dorsal aspect. In one instance of this kind the elongated stem of a young Comatula, or Crinoid of some kind, may be seen issuing from the orifice (fig. 1*d*).

Family XVIII. Cribrilinidæ, Hincks.

Cribrilinidæ, Hincks, Brit. Mar., Polyz., vol. i. p. 182.
Escharidæ (pars), Johnst., &c.
Membraniporidæ (pars), Busk.
Escharipоridæ (pars), Smitt.
Escharellidæ, &c., d'Orb.

Character.—Zoarium crustaceous, or adnate (lepralian), or erect and unilaminar (hemescharan). Zoœcia, front with transverse or radiating fissures or rows of punctures without fissures. Mouth simple, suborbicular, sometimes mucronate or semicircular; with or without a median suboral pore.

Cribrilina, Gray.

a. Front fissured.

§§ 1. *lepralian*.

(1) *Cribrilina radiata*, Moll.

(2) *Cribrilina latimarginata*, n. sp. (Pl. XXII. fig. 10).

§§ 2. *hemescharan*.

(3) *Cribrilina philomela*, n. sp. (Pl. XVII. fig. 6).

var. *α*, *adnata*, nov. (Pl. XXII. fig. 7).

§ *β*. Front, with punctures in more or less transverse rows.

(4) *Cribrilina labiosa*, Busk, var. *α*, *fragilis* (Pl. XIX. fig. 4).

(5) *Cribrilina monoceros*, Busk (Pl. XIX. fig. 8).

1. *Cribrilina*, Gray.

Cribrilina, Gray, Hincks, Smitt.
Cellepora (pars), Fabricius.
Eschara (pars), Moll.
Lepralia (pars), Brit. Mus. Cat., Johnst.
Reptescharella, d'Orb.
Escharipora, Smitt.

Character.—Front of cells fissured, or simply punctured in regular or irregular transverse rows.

§ *α*. Front fissured.

§§ 1. *Adnate* (*lepralian*).

(1) *Cribrilina radiata*, Moll.

Eschara radiata, Moll, Seerinde, p. 63, pl. iv. fig. 17.
Cribrilina radiata, Smitt, Florid. Bryoz., pt. 2, p. 22, pl. v. 107–108; Hincks, Brit. Mar. Polyz., vol. i. p. 185, pl. xxv. figs. 3, 4.
Lepralia radiata, Bk., Quart. Journ. Micr. Sci. vi., pp. 128, 263, pl. xx. fig. 4.

Habitat.—Station 75, lat. 38° 38′ N., long. 28° 28′ W., 450 fathoms, volcanic mud. Station 135A, off Inaccessible Island, Tristan da Cunha, 75 to 90 fathoms, hard ground, shells, gravel.

For further synonymy, more especially of fossil forms, reference may be made to Mr. Hincks' account of the species. It appears to be widely distributed throughout the North Atlantic zone and in the Mediterranean.

(2) *Cribrilina latimarginata*, n. sp. (Pl. XXII. fig. 10).

Character.—Zoœcia oval, completely immersed, the front surrounded by wide, thick, flattened borders or bands on each side, which arch over the orifice and meet,

leaving a fissure between their rounded and expanded ends. Orifice semicircular or subcrescentic, with a straight entire lower lip; peristome very slightly thickened, entire, even. The front of the zoœcia within the border formed of eight transverse, confluent costæ; the intercostal sulci with several minute pores and a large one at the outer end. No mesial line or fissure. Below the apex of each zoœcium is a large suborbicular opening, probably avicularian or vibracular. Oœcia inapparent.

Habitat.—Station 320, lat. 37° 17′ S., long. 53° 52′ W.; 600 fathoms, hard ground (on dead coral).

Reuss (Paläontologische Studien über die älteren Tertiärschichten der Alpen, p. 80, Pl. XXX. fig. 9), describes and figures under the name *Celleporaria radiata* a form, in some respects closely resembling *Cribrilina latimarginata* so far as the zoœcia are concerned. The sculpture of the front appears to be precisely the same, and there is also a large opening below each zoœcium. The differences, however, in other respects appear to be too great to allow of the supposition that the species are identical. According to Reuss, *Celleporaria radiata* consists of ascending irregularly branched stems, composed of concentric layers of cells; and the interzoœcial spaces, instead of being occupied by a broad solid band, present a series of very irregular, angular, unequal pores or cancelli, which sometimes attain a considerable size.

§§ 2. *Free; erect or decumbent* (*hemescharan*).

(3) *Cribrilina philomela*, n. sp. (Pl. XVII. fig. 6).

(?) *Cribrilina speciosa*, Hincks, Ann. and Mag. Nat. Hist., ser. 5, vol. viii. p. 8, pl. i. fig. 8, 1881.
(?) *Reptescharella inœqualis*, d'Orbigny, Palæont. Franç., p. 467, pl. 716, figs. 1-3.

Character.—Habit hemescharan; zoœcia oval, separated by deep sulci. Front rather flattened, with 7 to 8 shallow transverse fissures on each side, finely perforated; no suboral pore. Mouth large, semicircular or slightly coarctate, with a straight entire lower lip. Peristome thin and sharp. Occasionally minute erect tubuli occur in the interzoœcial sulci. Oœcia lofty, prominent, globose, slightly keeled in front, with a pyriform or crescentic stigma on each side; posterior wall of zoœcia entire, convex, very delicate.

Habitat.—Off Marion Island, 50 to 75 fathoms.

Var. *a. adnata* (Pl. XXII. fig. 7).

(?) *Cribrilina figularis*, var.

Character.—Closely adnate (lepralian). Occasionally a large spatulate vicarious avicularium. Zoœcia distant.

Habitat.—Off Marion Island, 50 to 75 fathoms (on a species of *Myriapora*). Station 151, Heard Island, 75 fathoms.

[? Curtis Island, Hincks].

As remarked by Mr. Hincks, with respect to his *Cribrilina speciosa*, with which I am strongly inclined to think the present form may be identical, it is closely allied to if not merely a variety of *Cribrilina figularis*, from which nevertheless it presents such considerable differences as to entitle it in my opinion to be regarded as distinct.

1. In it the costæ or fissures between them are more numerous and are not confined to a limited area of the front but occupy it entirely. 2. The costæ do not end peripherally in a prominent papilla or tubule as in *Cribrilina figularis* and *Cribrilina tubulifera*, Hincks. 3. The mouth is more arched above, and the lower lip is either perfectly straight in the older zoœcia or very slightly notched in the middle, corresponding to the termination of the median symphysial fissure, which remains visible in the younger ones. 4. In the transformation of a zoœcium into an avicularium, which, though perhaps not exactly homologous with the large avicularia occasionally seen dispersed between the zoœcia in *Cribrilina figularis* as noticed by Mr. Hincks and by Dr. Heller, answers the same purpose.

§ β. Front, with punctures in more or less distinct transverse rows.

(4) *Cribrilina labiosa*, Busk, var. *a*, *fragilis* (Pl. XIX. fig. 4).

Character.—Zoarium flexuose, delicate, white. Zoœcia barrel-shaped, front cribrate, with the openings in irregular transverse rows. Orifice horizontal, wide transversely; peristome much thickened on the sides and in front where it is produced into a wide projecting spout, and altogether deficient behind; an avicularium on each side deeply immersed within the orifice, with a curved, triangular, pointed mandible; no perceptible chitinous operculum.

Habitat.—Simon's Bay, Cape of Good Hope.

Though widely different in appearance the essential characters in the present form are exactly the same as those of the typical *Lepralia labiosa* (Brit. Mus. Cat. vol. i. p. 82, pl. xcv. figs. 4, 5). But in the description there given, the intra-oral avicularia and cribrate condition of the wall, which in that form is covered with a deep brown, thick epitheca are omitted, as is also the apparent absence of a chitinous operculum.

The species might well be regarded as the type of a distinct genus.

(5) *Cribrilina monoceros*, Busk, sp. (Pl. XIX. fig. 8).

Lepralia monoceros, Brit. Mus. Cat., vol. i. p. 72, pl. xciii. figs. 5, 6; Macgilliv., Nat. Hist. Vict., Dec. iv. p. 32, pl. xxxviii. figs. 1–2.

(?) *Lepralia larvalis*, Ibid. p. 30, pl. xxxvii. fig. 5.

Character.—Zoœcia deeply immersed, broad ovate, narrowing below. Primary mouth suborbicular and sinuated below; afterwards coarctate or horse-shoe shaped, and more deeply sinuated, with a sharp, internal (articular?) denticle on one or both sides; peristome thick; a short, thick, cylindrical process, usually only on one, but sometimes on both sides immediately outside the peristome, for the articulation of a long club-shaped

spine. In the older zoœcia the peristome in front rises into a strong, conical, rostriform process, upon which occasionally a small avicularium (with a triangular mandible) is developed below the apex in front; on many zoœcia an immersed avicularium (with an obtuse duck-bill shaped mandible) directed obliquely downwards. Wall of zoœcium cribriform, the large perforations surrounded with a thickened border. Zoœcia about 0″·02 wide. Orifice 0″·0075.

Habitat.—Station 163B, Port Jackson 35 fathoms, hard ground (on a *Carbasea*). Off Marion Island) surrounding the stem of an Alcyonarian, but not attached in either case). Station 303, lat. 45° 31′ S., long. 78° 9′ W.; 1325 fathoms, blue mud. Station 253, lat. 38° 9′ N., long. 156° 25′ W., 3125 fathoms (on a manganese nodule). Station 313, lat. 52° 20′ S., long. 68° 0′ W., 55 fathoms, sand. Station 315, lat. 51° 40′ S., long. 57° 50′ W., 12 fathoms, sand and gravel.

The specimen from Station 303 is more delicate, and the different parts are much less developed.

It might be a question whether the numerous forms that would come under § β should not be considered generically distinct from the fissured ones.

Family XIX. Microporellidæ.

Microporellidæ (pars), Hincks, Brit. Mar. Polyz., p. 204.
Eschariporidæ (pars), Smitt.
Celleporidæ (pars), Johnst., &c.
Membraniporidæ (pars), Busk.
Porinidæ (pars), d'Orb., Smitt.

Character.—Mouth semicircular or coarctate, with an entire straight lower border; a lunate fimbriated median pore. Zoarium erect and bilaminar, or crustaceous and adnate.

[I have ventured to modify Mr. Hincks' definition for the purpose of limiting it to such escharine forms as have a true lunate pore. Consequently, as here understood, it corresponds with Prof. Smitt's genus *Porellina* (Florid. Bryoz., p. 27). As thus constituted it appears to me to form a very natural group, divisible into two or perhaps three genera or sub-genera, distinguished by the presence of a vibracular or of a quasi-avicularian organ on one side of the front sometimes absent; and in part by the shape of the mouth.]

The Family here contains the following genera:—

§ α. Erect, bilaminar.

1. *Flustramorpha*, Gray.
   (1) *Flustramorpha marginata* (Krauss) (Pl. XX. fig. 8).
   (2) *Frustramorpha hastigera*, n. sp. ? (Pl. XXI. fig 7).

§ β. Crustaceous.

2. *Microporella*, Hincks.

(1) *Microporella personata* (Busk).
(2) *Microporella malusii* (Audouin).
(3) *Microporella ciliata* (Pallas).

The peculiar habit of growth of the *Flustra marginata* of Krauss, and which is also presented in the very closely allied *Eschara flabellaris*, Bk., was apparently regarded by Dr. Gray as sufficient for a generic distinction. But that it is not so is obvious from the circumstance that a similar condition obtains in species belonging to widely distinct genera.

It appears to me, therefore, convenient to merge all the erect bilaminar Microporellidan species, whether with or without the flexible fasciculate stem and marginal bundles of tubes, into one group for which Dr. Gray's name might be retained, but which, since they agree in all more essential characters, should perhaps be regarded more in the light of a sub-genus than as absolutely distinct from *Microporella*.

§ *a*. Erect, bilaminar.

1. *Flustramorpha*, Gray.

Flustramorpha, Gray.
Flustra (sp.), Krauss.
Eschara (pars), Auctt.
Mastigophora (sp.), Hincks.

Character.—Zoarium erect, radicate, bilaminar, composed of irregular lobes, bordered and loosely interconnected by chitinous tubes; mouth coarctate; a lateral pouch-like vibracularium.

(1) *Flustramorpha marginata*, Krauss (sp.) (Pl. XX. fig. 8).

Flustra marginata, Krauss, Corall. und Zooph. d. Südsee, p. 35, fig. 3.
Flustramorpha marginata, Gray.

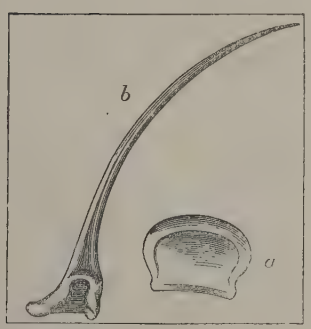


Fig. 39.—*Flustramorpha marginata*. *a*, Operculum; *b*, mandible.

Character.—Zoarium composed of strap-shaped lobes dividing more or less regularly in a furcate manner, and bordered by a bundle of chitinous tubes continuous downwards into a peduncle. Zoœcia broad, ovate, or subhexagonal, flattened in front, and separated by shallow sulci. Mouth arched above, contracted below (coarctate); lower border straight, entire, smooth; a lunate pore whose lower edge is toothed; on one side of the front a large pouch-like vibraculum with a long setose flagellum. Surface finely granular. Oœcia globose, prominent, though slightly immersed at the base.

Habitat.—Station 142, lat. 35° 4′ S., long. 18° 37′ E.; 150 fathoms, green sand. Off Marion Island, 50 to 75 fathoms.

[Natal, Bolton; South Africa, Krauss].

(2) *Flustramorpha hastigera*, n. sp. ? (Pl. XXI. fig. 7).

? *Porellina ciliata*, Smitt, Florid. Bryoz., p. 26, pl. vi. figs. 126–129.

Character.—Zoarium ramose, branches short, ligulate, expanding at the ends, dichotomous. Zoœcia broad ovate, very convex, surface granular. Mouth semicircular, lower border straight, entire; peristome slightly thickened; three or four oral spines above, (often absent). The lunate pore close below the mouth. An aviculario-vibracular organ on one side, the basal part of the mandible triangular, the apex being turned up at a right angle and produced into a spear-shaped acute flagellum.

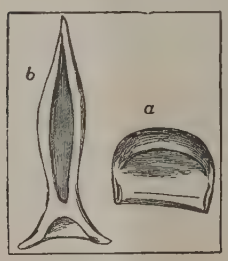


Fig. 40.—*Flustramorpha hastigera*. *a*, Operculum; *b*, mandible.

Habitat.—Station 75, lat. 38° 38′ N., long. 28° 28′ W., 450 fathoms, volcanic mud.

In the general character of the zoœcia this form very closely resembles *Microporella ciliata*, and even in the vibraculoid character of the avicularium, a close correspondence in some respects exists, for in the latter species the acute mandible of the lateral avicularium, as noticed by Mr. Hincks, "is often prolonged into a slender vibraculoid spine or process." And in like manner in *Flustramorpha hastigera* what might be termed the triangular mandible turns up at the apex, and is produced into a beautiful spear-shaped blade of considerable length, whilst the horizontal basal part forms a fork by which it is articulated and furnished with muscles, in such a way as to admit of motion only in one plane, and to be shut down upon the rostral portion of the avicularium.

Precisely the same conditions obtain in *Flustramorpha flabellaris*, Bk., and *Flustramorpha patagonica*, n. sp.? except that in those two forms, as in *Microporella ciliata*, the flagelliform prolongation is not turned up so abruptly. It is curious to remark that this appendage is almost exactly like that of the anterior immoveable spine of *Lepralia spathulifera*, Smitt. In all these cases, therefore, this form of *flagellum* is apparently adapted only for defensive purposes.

§ *β*. Crustaceous.

2. *Microporella*, Hincks.

Microporella (pars), Hincks, 1877.
Cellepora (pars), Linn.; Audouin.
Lepralia (pars), Johnst.; Busk, &c.
Escharina (pars), Milne-Edw.; Gray.
Herentia (sp.), Gray.
Reptoporina (pars), D'Orbigny.
Porina, *Porellina*, Smitt.

Character.—Zoarium erect and bilaminar, or encrusting and adnate. Mouth semi-

circular, with a straight entire lower border, with or without oral spines. An aviculario-vibracular organ on one side of the front with the mandible forked at the base; or unarmed.

(1) *Microporella personata*, Busk, sp.

Lepralia personata, Bk., Brit. Mus. Cat., p. 74, pl. xc. figs. 2, 3, 4.
Microporella ciliata, var., Hincks, Brit. Mar. Polyz., vol. i. p. 209.

Character.—Zoœcia immersed, oblong, surface punctured. Mouth semicircular, lower lip straight, prominent, entire; five to seven oral spines above; a long avicularian vibraculum on one or both sides of the front. Oœcium smooth, cucullate; in the fertile cells the lower lip is much produced in front.

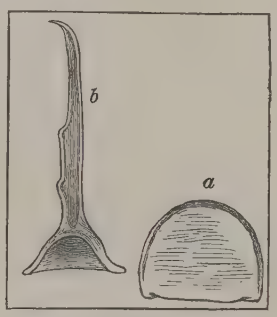


Fig. 41.—*Microporella personata*. *a*, Operculum; *b*, mandible.

Habitat.—Station 208, lat. 11° 37′ N., long. 123° 31′ E., 18 fathoms, blue mud (on a dead shell).

[Falkland Islands, 4 to 10 fathoms, on stones and *Fuci*, Darwin.]

Though perhaps closely related to *Microporella ciliata*, I think the great and constant difference in the fertile cells sufficient as a specific distinction.

(2) *Microporella malusii*, Audouin (sp.).

Cellepora malusii, Audouin.
Lepralia biforis, Johnst.
Herentia biforis, Gray.
Escharina cornuta, d'Orb.
Reptoporina malusii, d'Orb.
Lepralia malusii, Busk, Heller, Manzoni, &c.
Porina malusii, Smitt.
Microporella malusii, Hincks.

Character.—Cells ovate, truncate at each end; front, especially round the margin, punctured with numerous stelliform pores; a large central lunate pore; mouth semicircular, straight below, sometimes armed with three or four oral spines, which are occasionally forked. Oœcium smooth, sometimes porcellanous, grooved or areolated round the upper border, adnate to the front of the cell above.

Habitat.—Station 315, lat. 51° 40′ S., long. 57° 50′ W., 5 to 12 fathoms, sand and gravel. Station 135c, off Nightingale Island, Tristan da Cunha, 110 to 150 fathoms.

[Cosmopolitan.]

(3) *Microporella ciliata*, Pallas (sp.).

Eschara ciliata, var. β. Pall. Elench.
Cellepora ciliata, Linn.
Lepralia ciliata, Johnst., Bk., W. Thompson, Macgilliv., Gray.
„ *insignis*, Hassall.
„ *lunata*, Macgilliv.
„ *utriculus*, Manzoni.
Escharina vulgaris (pars), Milne-Edw.
(?) *Flustra genisii*, Audouin.
Porina and *Porellina ciliata*, Smitt.
Microporella ciliata, Hincks.

Habitat.—Station 135c, off Nightingale Island, Tristan da Cunha, 110 to 150 fathoms. [Cosmopolitan.]

Family XX. Escharidæ.

Escharidæ (pars), Johnst., d'Orb., Busk, Smitt, Hincks, &c.
Myriozoidæ (pars), Smitt, Hincks.

Character.—Zoarium calcareous, radicate or fixed; erect, uni- or bi-laminar, foliaceous or ramose; or crustaceous, loosely attached or adnate. Zoœcia urceolate, front entirely calcified.

§ 1. Lower lip of primary orifice entire.

§§ α. Erect, bilaminar.

1. *Eschara*, Pallas.

(1) *Eschara elegantula*, d'Orbigny (Pl. XX. fig. 6).
(2) *Eschara gracilis*, Milne-Edwards (Pl. XXI. fig. 6).

§§ β. Crustaceous, unilaminar.

2. *Lepralia*, Johnston.

(*a*) Free or loosely attached.

(1) *Lepralia celleporoides*, n. sp. (Pl. XVII. fig. 4).
(2) *Lepralia japonica*, n. sp. (Pl. XVII. fig. 5).
(3) *Lepralia tuberosa*, n. sp. (Pl. XVII. fig. 7).
(4) *Lepralia dorsiporosa*, n. sp. (Pl. XVIII. fig. 4).

(*b*) Adnate.

(5) *Lepralia feegeensis*, n. sp. (Pl. XXII. fig. 9).
(6) *Lepralia margaritifera* (Quoy and Gaymard).
(7) *Lepralia incisa*, n. sp. ? (woodcut).
(8) *Lepralia lonchæa*, n. sp. (woodcut).
(9) *Lepralia marsupium*, Macgillivray (woodcut).

3. *Chorizopora*, Hincks.

(1) *Chorizopora brongniartii* (Audouin).
(2) *Chorizopora hyalina*, var. *bougainvillei*, Busk (Pl. XXII. fig. 4).
(3) *Chorizopora honolulensis*, n. sp. (Pl. XXII. fig. 12).

4. *Porella*, Gray.

(1) *Porella lævis*, var. *subcompressa*, Hincks (Pl. XX. fig. 3).

5. *Escharoides*, Smitt.

(1) *Escharoides occlusa*, n. sp. (Pl. XXI. fig. 8).
(2) *Escharoides verruculata* (Smitt).

6. *Smittia*, Hincks.

(*a*) Bilaminar.

(1) *Smittia tenuis*, n. sp.? (Pl. XX. fig. 1).

(*b*) Unilaminar.

(2) *Smittia smittiana*, n. sp. (Pl. XVII. fig. 3).
(3) *Smittia marsupialis*, n. sp. (Pl. XVIII. fig. 1).
(4) *Smittia transversa*, n. sp. (Pl. XVIII. fig. 7).
(5) *Smittia marionensis*, Busk (Pl. XVIII. fig. 6).
(6) *Smittia jacobensis*, n. sp. (Pl. XIX. fig. 7).

(*c*) Adnate.

(7) *Smittia oratavensis*, n. sp. (Pl. XXII. fig. 1).
(8) *Smittia stigmatophora*, n. sp. (Pl. XXII. fig. 6).
(9) *Smittia graciosa*, n. sp.? (Pl. XXII. fig. 13).

7. *Mucronella*, Hincks.

(*a*) Bilaminar.

(1) *Mucronella contorta* (Busk) (Pl. XX. fig. 9).
(2) *Mucronella pyriformis*, n. sp. (Pl. XX. fig. 5).

(*b*) Unilaminar, free or loosely attached.

(3) *Mucronella quadrata*, n. sp. (Pl. XVIII. fig. 5; Pl. XVII. fig. 8).
(4) *Mucronella delicatula*, n. sp. (Pl. XVIII. fig. 2).
(5) *Mucronella rostrigera*, n. sp. (Pl. XIX. fig. 2).
(6) *Mucronella bisinuata* (Smitt) (Pl. XIX. fig. 5).
(7) *Mucronella castanea*, n. sp. (Pl. XIX. fig. 6).
(8) *Mucronella magnifica*, n. sp. (Pl. XVIII. fig. 3).

(*c*) Adnate.

(9) *Mucronella canalifera*, n. sp. (Pl. XXII. fig. 2).
(10) *Mucronella tricuspis*, Hincks (Pl. XXII. fig. 3).
(11) *Mucronella simplicissima*, n. sp. ? (Pl. XXII. fig. 5).
(12) *Mucronella ventricosa*, var. *multispinata*, Busk (Pl. XXII. fig. 11).

8. *Aspidostoma*, Hincks.
Aspidostoma giganteum (Busk) (Pl. XXXIII. fig. 3).

§ 2. Primary mouth notched or sinuated below.

9. *Schizoporella*, Hincks.
(*a*) Bilaminar.
(1) *Schizoporella furcata*, n. sp. (Pl. XXI. fig. 5).

(*b*) Unilaminar, free or loosely attached.
(2) *Schizoporella nivea*, n. sp. (Pl. XVII. fig. 1).
(3) *Schizoporella longispinata*, n. sp. (Pl. XVII. fig. 2).
(4) *Schizoporella auriculata* (?) Hassall, var. *alba*, nov. (Pl. XIX. fig. 1).
(5) *Schizoporella jacksoniensis*, n. sp. (Pl. XIX. fig. 3).
(6) *Schizoporella tenuis*, n. sp. (Pl. XX. fig. 10).

(*c*) Adnate.
(7) *Schizoporella elegans*, d'Orbigny (Pl. XXII. fig. 8).
(8) *Schizoporella marsupifera*, n. sp. (Pl. XXII. fig. 14).
(9) *Schizoporella cecilii* (Audouin).
(10) *Schizoporella circinata* (Macgillivray) (woodcut).
(11) *Schizoporella triangula*, Hincks.

10. *Gephyrophora*, n. gen.
Gephyrophora polymorpha, n. sp. (Pl. XXXIV. fig. 2).

11. *Myriozoum*, Donati.
(1) *Myriozoum honolulense*, n. sp. (Pl. XXV. fig. 2).
(2) *Myriozoum immersum*, n. sp. (Pl. XXV. fig. 4).
(3) *Myriozoum simplex*, n. sp. (Pl. XXV. fig. 1).
(4) *Myriozoum marionense*, n. sp. (Pl. XXIII. fig. 6).

12. *Haswellia*, n. gen.
(1) *Haswellia australiensis* (Haswell) (Pl. XXIV. fig. 9).
(2) *Haswellia auriculata*, n. sp. (Pl. XXIV. fig. 10).

13. *Tessaradoma*, Norman.

Tessaradoma boreale (Busk) (Pl. XXIV. fig. 8).

14. *Gemellipora*, Smitt.

(*a*) Erect and ramose.

(1) *Gemellipora glabra*, Smitt (Pl. XXV. fig. 3).

(*b*) Adnate.

(2) *Gemellipora cribritheca*, n. sp. (Pl. XXXIII. fig. 5).

§ 1. Lower lip of primary orifice entire.

Primary mouth persistent, lower border entire usually straight; operculum semicircular. Oral avicularia, when present, median, and external to the peristome.

§§ *a*. Erect, bilaminar.

1. *Eschara*, Pallas.

Eschara (pars), Ray, Johnst., Lamk., d'Orb., Busk, Smitt, Milne-Edw., &c.
Cellaria (pars), Reuss.
Acropora (pars), Reuss.
Lepralia (pars), Hincks, Smitt, &c.

Character.—Zoarium erect (sometimes decurrent); foliaceous or ramose compressed, bilaminar.

(1) *Eschara elegantula*, d'Orbigny (Pl. XX. fig. 6).

Eschara saccata, Bk., Ann. Nat. Hist., ser. 2, vol. xviii., p. 33, pl. 1. fig. 5, 1856; Sars. Beskr. o. n. Norske Polyzoer, p. 6, 1862.
? *Eschara elegantula*, d'Orbigny (*teste* Smitt), Palæont. Franç., p. 102; Smitt, Kritisk Förteckn., pp. 24, 154.

Character.—Zoarium (of considerable size), branched dichotomously in one plane, branches of various breadths, widening at the ends. Zoœcia cylindrical or barrel-shaped, orifice terminal, horizontal (looking directly upwards) arcuate. The front of zoœcium nearly entirely occupied by a large pouch-like avicularium, with a semicircular mandible, pointing forwards. Oœcia immersed, convex cucullate. The entire surface smooth and shining.

Habitat.—Station 48, lat. 43° 4′ N., long. 64° 5′ W., 51 fathoms, rock.

[Banks of Newfoundland, d'Orbigny; Spitzbergen, Greenland, Finmark, Forell, Sars, M'Andrew.]

(2) *Eschara gracilis*, Lamarck (Pl. XXI. fig. 6).

Eschara gracilis, Lamk.; Lamx.; Blainv.; Milne-Edw.; Brit. Mus. Cat., Macgilliv., &c.
Cellaria and *Acropora coronata*, Reuss.
? *Eschara buskii*, Tenison Woods, Journ. Roy. Soc. Vict.

Character.—Zoarium much and irregularly branched in various directions. Branches subcompressed, varying in breadth from 0″·15 to ·25. Zoœcia at the growing extremity ventricose and subtubular towards the orifice; in all other parts completely immersed, so that no outlines are discernible, the thickened annular orifices alone projecting from a level surface, which is closely and uniformly pitted. Orifice suborbicular, peristome very thick, annular, entire, and on it are placed from five to eight small circular avicularia on as many tubercular elevations. An elongate sublateral pore or fissure some distance below the orifice. Oœcia—?

Habitat.—Station 190, lat. 8° 56′ S., long. 136° 5′ E., 49 fathoms, green mud. Station 162, off East Moncœur Island, 38 fathoms, sand and shells.

[Bass Strait, Voy. of Rattles.; tertiary fossil, Reuss; Miocene? Tenison Woods.]

Although Dr. Reuss describes a central pore of large size, it is not represented in his figure of *Acropora coronata*. But there can, I think, be little doubt that the present species is identical with the tertiary form, as well as with that described by the Rev. Tenison Woods from the Mount Gambier deposits, under the name of *Eschara buskii*.

If the peculiar characters of this form be regarded as of generic value, which I think they might be, Reuss' appellation *Acropora* would be very appropriate.

§§ *β*. Crustaceous, unilaminar.

2. *Lepralia*, Johnston.

Lepralia, Hincks, Smitt.
„ (pars), Brit. Mus. Cat., Auctt.
Eschara (pars), Auctt.
Hemeschara (pars), Busk, &c.

Character.—Zoarium unilaminar, erect or crustaceous, and loosely or wholly unattached; or adnate with the zoœcia, incomplete behind.

(*a*) Unilaminar, erect or crustaceous, free or loosely attached (hemescharan).

(1) *Lepralia celleporoides*, n. sp. (Pl. XVII. fig. 4).

Character.—Zoarium unattached, sometimes one layer overgrowing another. Zoœcia completely immersed, convex in front, separated by wide and deep sulci, at the bottom of which are large pores or cancelli. Zoœcia broadly oval, surface entire, finely granular, except a very large central subreniform or orbicular pore, which in the natural state is closed by a delicate membrane, and has a slightly raised border. Orifice coarctate, rostriform. In the older cells a tubercular elevation immediately below the mouth. An immersed avicularium is placed in the sulcus between each pair of cells, on a level with the orifice, with a duck-bill shaped mandible, directed usually vertically upwards, but occasionally in other directions.

Habitat.—Station 186, lat. 10° 30′ S., long. 142° 18′ E., 8 fathoms, coral mud.

(2.) *Lepralia japonica*, n. sp. (Pl. XVII. fig. 5).

Character.—Zoarium thick, unattached, covered with a rather thick, yellowish-brown, opaque chitinous epitheca. Zoœcia, in front, pyriform, broadly truncate below, slightly convex or tumid. Surface beneath the epitheca sparsely but uniformly punctured. Orifice somewhat immersed, arched; lower lip nearly straight, entire. On the dorsal aspect the zoœcia are quadrilateral and nearly square; surface punctured. Interzoœcial wall with numerous pores or plates. Oœcia inapparent. Zoœcia about 0″·05 × ·025. Orifice 0″·01.

Habitat.—Cobie, Japan, 8 to 50 fathoms.

(3) *Lepralia tuberosa*, n. sp. (Pl. XVII. fig. 7).

Character.—Zoarium very thick and coarse-looking, attached by long radical tubes springing from the back of the zoœcia. Zoœcia viewed in front broadly oval or arched above and much contracted below the middle. Convex, separated by moderately deep sulci; obscurely punctured round the border and at the base of the tuberosity. Orifice orbicular with three small points on the lower lip. Operculum rounded or arched above and contracted at the lower part, with a projecting point on either side (continuations of the marginal rim); with a crescentic, transverse, punctured and bordered area, and several faint longitudinal rugæ, the membrane very finely punctured all over. Peristome very thick, supporting on each side towards the front a small circular, slightly elevated avicularium (with a short duck-bill shaped mandible); four strong articulated oral spines above. On the front of the zoœcium, when mature, a very large conical hollow protuberance or tuberosity supporting one or several avicularia on the sides and near the summit (but not on it). These avicularia differ in size and direction, but all have a short, broad, rounded mandible. In the older zoœcia, besides the enormously developed main tuberosity, several others appear, all supporting similar avicularia. On the dorsal aspect the zoœcia appear more or less hexagonal, with an acute angle at the top and bottom. The surface is punctured, and presents a large subclithridiate aperture from which a long cylindrical chitinous radical tube issues. Orifice about 0″·01 wide.

Habitat.—Station 163B, off Port Jackson, 35 fathoms, hard ground.

(4) *Lepralia dorsiporosa*, n. sp. (Pl. XVIII. fig. 4).

Character.—Zoarium thick, epitheca white. Zoœcia elongated, hexagonal in front, and separated by thin raised septa; a small triangular notch or fold in the centre above the orifice; behind, the zoœcia are broadly ovate. Anterior surface flat but

not depressed, punctate, punctures very regularly quincuncial. Orifice semicircular, slightly coarctate, about 0″·01 wide, lower lip straight entire or sometimes showing a few very shallow notches close to the angle. A minute internal conical tooth (? articular) on each side. On some of the cells a small immersed avicularium on one or both sides of the orifice, of an oval form (with a triangular mandible looking downwards). Dorsal surface vitreous, transversely wrinkled, with a large oval or reniform opening closed by a perforated membrane and with a raised but not thickened border, and besides this, one or several small circular pores also with raised margins, from which proceed flexible radical tubes, the wall of which is very finely annulated. Lateral interzoœcial plates, small and circular, eight in number, disposed in alternate rows (four to each of the contiguous cells).

Habitat.—Station 186. Cape York, lat. 10° 30′ S., long. 142° 18′ E.; 8 fathoms, coral mud.

This fine species exemplifies, in the most striking manner, the structure of a hemescharine zoarium. It is loosely attached, apparently by long flexible radical tubes, to subjacent bodies, probably coral, and besides these tubes each zoœcium has a gigantic "perforated plate," the function of which, in such a situation, appears to be very obscure. It is clear, however, that it is not for the purpose of keeping up any communication with a contiguous zoœcium, although in structure it precisely resembles those "Rosettenplatten" which occur on the walls of contiguous cells and have been supposed to be for the purpose of communication between the two.

(*b*) Adnate (lepralian).

(5) *Lepralia feegeensis*, n. sp. (Pl. XXII. fig. 9).

Character.—Zoœcia very large, 0″·05, completely immersed so as to form an almost level surface, slightly convex in front, oblong and rectangular, disposed in linear series; surface smooth, very finely and obscurely punctured. Mouth large, slightly coarctate, with a straight prominent lower lip. On many of the zoœcia, on each shoulder, on the sides of the orifice, a horizontal immersed avicularian (with an elongated acute mandible pointing directly inwards). Oœcia inapparent.

Habitat.—Station 208, lat. 11° 37′ N., long. 123° 31′ E., 18 fathoms, blue mud (on a dead shell).

[Hongkong, Dr. Harland.]

A very remarkable form, in which is well displayed the mode in which the marginal growth of the colony is effected. Each of the contiguous series of zoœcia is produced a long way in front of the last inhabited one, in a perfectly smooth chitinous expansion, extending to the length of two or three of the zoœcia, and in which scarcely any indica-

tion of the future differentiation into separate cells is to be observed, except in the part immediately continuous with the last inhabited zoœcium, a faint trace marking the outline of the future mouth, and a still fainter indication of the distal limit of the zoœcium; beyond this no indications even of this faint kind are to be seen.

(6) *Lepralia margaritifera*, Quoy and Gaymard (sp.).

Flustra margaritifera, Quoy and Gaymard, Voy. de l'Uranie, pl. 92, figs. 7, 8.
Lepralia margaritifera, Bk., Brit. Mus. Cat., vol. ii. p. 72, pl. ci. figs. 5, 6.

Character.—Cells deeply immersed, with a row of marginal punctures; front of cell raised into an elevated umbo, on the upper side of which is often a small avicularium with a rounded mandible and numerous larger and smaller, mostly retentive avicularia irregularly distributed; mouth large, suborbicular, with a thickened margin. Oœcium umbonate.

Habitat.—Station 315, lat. 51° 40′ S., long. 57° 50′ W., 12 fathoms, sand and gravel.

[Tierra del Fuego, Falkland Islands, Darwin; Kerguelen Island, Eaton.]

(7) *Lepralia incisa*, n. sp.?

Character.—Zoœcia quincuncial, ovate; very convex, thick interzoœcial septa. Surface closely pitted (not punctate). Orifice arched above, slightly contracted below; the lower border slightly concave, a very minute articular notch on each side. Peristome even with the surface, very slightly thickened; on each side of the orifice a small oval immersed avicularium.

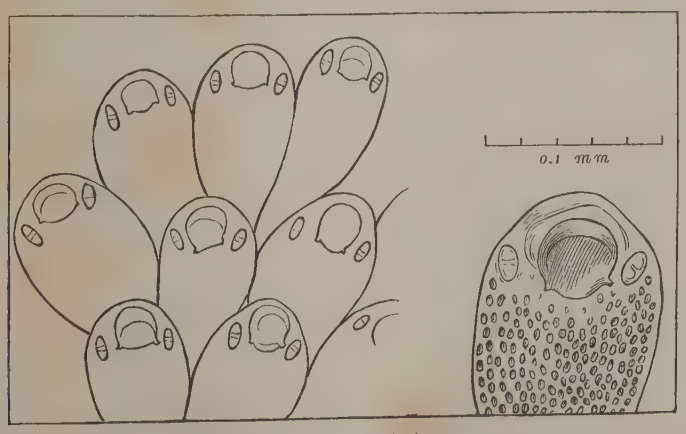


Fig. 42.—*Lepralia incisa.*

Habitat.—Inaccessible Island, 60 to 90 fathoms.

The collection affords only a single specimen of this species parasitic apparently on a white coral. At first sight it resembles some varieties of *Schizoporella ansata*, but the form of the oral orifice is quite different, belonging to the type assigned to *Gemellipora* by Prof. Smitt, and represented in his *Gemellipora lata* (Florid. Bryoz., p. 36, pl. vii. fig. 157), the peculiarity of the Gemelliporan orifice consisting in the presence of a minute articular notch instead of a tooth on each side, and the deep excavation of the lower border. But the broad quadrangular form of the orifice in this case contrasted with its elongate pyriform shape in *Gemellipora glabra*, &c., and the truly lepralian habit of the growth lead me rather to place it under the genus *Lepralia* as here understood. The existence of an avicularium on each shoulder of the cell is of course common to numerous species. In their small size in the present species they more resemble those of *Lepralia woodiana*, Bk., than any other. As the only specimen in the collection is dead, I have been unable to avail myself of the characters afforded by the chitinous parts and can only supply instead the accompanying figure of the oral orifice.

(8) *Lepralia lonchæa*, n. sp.

Character.—Zoarium adnate (on shell). Zoœcia immersed and widely ventricose below, produced and contracted, almost subtubular above, with the orifice directed forwards. Mouth rounded oblong, with a minute articular notch on each side below; lower border entire, slightly curved; peristome thin, raised all round, sometimes slightly channelled in front. On many zoœcia, on one side of the neck-like peristome, an upright avicularium with a long spear-shaped mandible pointing directly upwards. Operculum about 0·02 mm. in diameter, suborbicular, with a minute tubercle on each side corresponding to the articular notches.

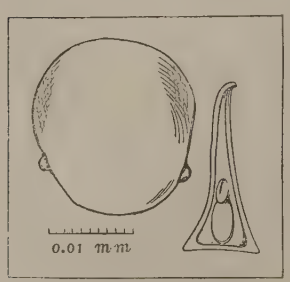


Fig. 43.—*Lepralia lonchæa*. Operculum and mandible.

Habitat.—Admiralty Islands, lat. 2° 0′ S., long. 147° 20′ E.

The elevated peristome is like that which affords the main character of Mr. Hincks' artificial genus *Phylactella*, but the shape of the oral orifice is, with the exception of the two little articular notches, so precisely like that of *Lepralia pallasiana* and *Lepralia pertusa*, that taking also into account the presence of avicularia, I have thought that it should be classed with the other forms to which Prof. Smitt and Mr. Hincks have limited the generic name *Lepralia*. It is very closely allied to the preceding species, but the form of the cells, the produced oral part and the elevated peristome, together with the altogether different avicularia, render them manifestly distinct. To the same group perhaps might be referred *Gemellipora lata* and *Discopora pertusa* (Smitt, Florid. Bryoz., p. 72, pl. xii. fig. 240), [? *nec* Auctt.].

(9) *Lepralia marsupium*, Macgillivray.

Lepralia marsupium, Macgilliv., Nat. Hist. Vict., Dec. iv. p. 22, pl. xxxv. fig. 4.
Porella marsupium, Hincks; Macgilliv., Proc. Roy. Soc. Vict., pt. 3, 1882, pl. i. fig. 2.
? *Porella minuta*, Norman.
Schizoporella marsupium, S. O. Ridley, Proc. Zool. Soc., 1881, p. 48.

Character.—Zoœcia ventricose, subquadrangular, deeply immersed, surface granular; primary orifice arched above, with a straight or slightly sinuated lower border, in front of which is a pouch-like avicularium with a semicircular mandible, placed horizontally. Three or four articulated marginal spines above (usually detached). Oœcia (very numerous) globose, smooth. Operculum semicircular, the lower border with two very obtuse angles.

Habitat.—Station 315, lat. 51° 40′ S., long. 57° 50′ W., 12 fathoms, sand and gravel. [Australia, Macgillivray.]

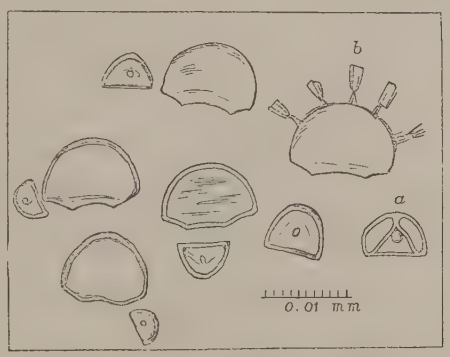


Fig. 44.—*Lepralia marsupium.*
a, Mandible of *Porella compressa*.
b, Operculum and oral spines of *Lepralia marsupium*.

At first sight this form might readily be taken for a *Porella*, as in fact it is considered by Mr. Hincks, who also suggests that the Australian form is nearly related to Dr. Norman's *Lepralia minuta* from Guernsey and Shetland. This I think is highly probable. But neither Mr. Hincks in his description of *Porella marsupium* (Ann. and Mag. Nat. Hist. ser. 5, vol. viii. p. 123, 1881) nor Mr. Norman make any mention of the oral spines noticed by Mr. Macgillivray, which are present in the Challenger specimen on the marginal cells. Mr. Hincks further speaks of a tooth on the lower margin, which I should imagine would in his system have made the species either a *Mucronella* or a *Smittia*, but this I think is an error into which I at first fell myself; for in the Challenger specimen, the apparent tooth is in reality merely the projection upwards of the lower border of the median avicularium, which appears to occupy the same position, and to stand in the same relation to the mouth, as the median avicularium does in *Eschara foliacea* and not to be within its verge as in the typical *Porellæ*. In all the true *Porellæ*, moreover, the avicularian mandible presents a minute but constant character (not altogether however confined to that genus), which is wanting in the mandible of *Lepralia marsupium*, viz., the existence of a curved chitinous rod on each side of the central foramen, as shown at *a*, in the accompanying woodcut (fig. 44) which represents the mandible of *Porella compressa*. The existence of oral spines is clearly proved by their chitinous remains as shown at *b*.

3. *Chorizopora*, Hincks.

Chorizopora, Hincks, Brit. Mar. Polyz., p. 222.
Mollia (sp.), d'Orb., Smitt, *nec* Lamx.
Flustra (sp.), Audouin.
Lepralia (sp.), Brit. Mus. Cat., Macgilliv., Hassall, Johnst., Gray, &c.
Hippothoa (pars), Smitt.
Schizoporella (pars), Hincks.

Character.—Zoœcia often distinct, connected by hollow calcareous processes. Mouth semicircular or suborbicular, with a straight or sinuated lower border. Oœcial orifice crescentic. Wall of zoœcia usually transversely wrinkled.

The name *Mollia*, originally applied by Lamouroux to two or three species of Membranipora, has been used in so many senses since, that I quite agree with Mr. Hincks in disusing it. But the genus as it stands is at present ill defined. I include under it the various forms, more or less closely allied to *Lepralia hyalina*, Auctt.

(1) *Chorizopora brongniartii*, Audouin (sp.).

Chorizopora brongniartii, Hincks.
Flustra brongniartii, Audouin, Expl. i. p. 240.
Lepralia tenuis, Hassall.
Lepralia assimilis, Johnst.
Lepralia brongniartii, Bk., Brit. Mus. Cat., vol. i. p. 65, pl. lxxxi. figs. 1–5, Heller, Manzoni.
Lepralia capitata, Reuss.
Mollia brongniartii, d'Orbigny.

Habitat.—Simon's Bay, Cape of Good Hope, 18 fathoms (on a dead shell).

[Mediterranean, Adriatic, North Atlantic, lat. 47° 35′–58′ N., long. 7° 6′ W., 89–205 fathoms. Coasts of France and Britain; Coralline Crag; Pliocene at Volterra and Miocene at Castrocaro.]

Savigny's figure ("Egypte," pl. x. fig. 6), appears to me more like a variety of *Chorizopora hyalina*, as it shows no trace of avicularia.

(2) *Chorizopora hyalina*, var. *bougainvillei* (Pl. XXII. fig. 4).

Escharina bougainvillei, d'Orbigny, Amér. Mérid. p. 12, pl. iv. figs. 9–12.
Lepralia hyalina, var. *bougainvillei*, Bk., Kerguelen Polyz., p. 5, pl. x. fig. 10.

Habitat.—Station 149D, Royal Sound, Kerguelen Island, 28 fathoms, volcanic mud. Station 315, lat. 51° 40′ S., long. 57° 50′ W.; 12 fathoms (on a species of *Carbasea*). Station 135A, off Inaccessible Island, Tristan da Cunha, 75 to 90 fathoms, hard ground, shells, gravel.

[Swain's Bay, Kerguelen, Eaton.]

(3) *Chorizopora honolulensis*, n. sp. (Pl. XXII. fig. 12).

Character.—Zoœcia erect and subtubular above, deeply immersed at the base, and ventricose. Large open spaces or cancelli in the interzoœcial sulci, and constantly a large

one immediately above each zoœcium. Surface very rough and uneven. Primary mouth orbicular, entire; afterwards, by the elevation of the peristome, is formed a deep, infundibuliform cup, at the bottom of which the small primary orifice is visible; peristome thick, entire. Oœcia inapparent.

Habitat.—Off Honoruru, Sandwich Islands, 20 to 40 fathoms (inside a dead shell).

[There is only a single small worn specimen in the collection. I place the species with *Chorizopora* simply on account of the distant zoœcia, but its family position is quite uncertain, though it would appear to come within d'Orbigny's definition of *Mollia*.]

4. *Porella*, Gray.

Porella, Hincks, Smitt (pars), Gray, Brit. Mar. Rad., pp. 127, 128.
Cellepora (pars), Fleming.
Eschara (pars), Sars, Bk., Alder, Smitt, &c.
Hemeschara (pars), Norman.
Lepralia (pars), Bk., &c.

Character.—Zoarium erect ramose, cylindrical or subcompressed; or crustaceous and adnate. A median oral avicularium within the primary mouth, with a semiorbicular or subtriangular mandible.

[The peculiar framework of the mandible, in the genus *Porella*, is shown at *a*, woodcut 44, p. 147.]

(1) *Porella lævis*, var. *subcompressa*, Hincks (Pl. XX. fig. 3).

Character.—Zoarium with the general habit of *Porella lævis*, with the branches subcompressed and bilaminar.

Habitat.—Porto Praya, St. Iago, Cape de Verde, 100 to 150 fathoms.

[The difference between this and the usual cylindrical form of the northern *Porella lævis* is sufficient to mark it as a distinct variety. In the chitinous parts there is no difference except that the avicularian mandible is on the whole larger, and usually exhibits a median tooth on the inside at the top. But it has the same elevated arched form and not the depressed semicircular shape of the mandible in *Porella compressa*.]

5. *Escharoides*, Smitt.

Eschara (pars), Auctt.
Escharoides, Smitt, Hincks. ? Milne-Edw. (pars).

Character.—Secondary orifice sinuated below, with an avicularium on one or both sides of the notch.

(1) *Escharoides occlusa*, n. sp. (Pl. XXI. fig. 8).

Character.—Zoarium thick, irregularly branched in one plane. Branches varying in breadth from 0″·25 to ·1 with from 5 to 8 zoœcia in the width. Zoœcia distinct, and open towards the ends of the branches or lobes; in the older portions much over-grown with a porcellanous accretion by which the orifice is completely obliterated. The younger zoœcia ovate, broad, surface uneven, widely punctured. Orifice (primary) arcuate with a nearly straight and entire lower lip, or suborbicular; afterwards the lower border becomes sinuate and the peristome much thickened, and on one side of the shallow, oral sinus thus formed a rather large immersed avicularium with a triangular mandible pointing upwards is developed. Oœcia deeply immersed, with several irregular fissures or triangular punctures in front.

Habitat.—Station 148, lat. 46° 47′ S., long. 51° 37′ E., 210 fathoms, hard ground, gravel and shells. Station 186, Cape York, lat. 10° 30′ S., long. 142° 18′ E.; 8 fathoms, coral mud. Samboangan, 10 fathoms.

(2) *Escharoides verruculata*, Smitt (sp.).

Cellepora verruculata, Smitt, Florid. Bryoz., pt. 2, p. 50, pl. viii. figs. 170–172.

Habitat.—Station 151, off Heard Island, 75 fathoms, mud.
[West of Tortugas, Gulf of Mexico, Pourtalès].

6. *Smittia*, Hincks.

Eschara (pars), Auctt.
Berenicea (pars), Johnst.
Lepralia (pars), Johnst., Bk., &c.
Escharella, Smitt, Öfv. K. Vet. Ak. Förh. 1878 (*nec Escharella* Gray *nec* d'Orb.).
Smittia, Hincks, Ann. and Mag. Nat. Hist., ser. 5, vol. iii. p. 160, 1879.

Character.—Zoarium erect bi- or uni-laminar or crustaceous free or adnate. Primary orifice entire, with an internal median denticle. Secondary orifice canaliculate, usually enclosing a median avicularium.

(*a*) Bilaminar (escharan).

(1) *Smittia tenuis*, n. sp. ? (Pl. XX. fig. 1).

Character.—Zoarium dichotomously branched (?) not always in the same plane; compressed. Zoœcia completely immersed, pyriform, bordered by a single row of punctures, surface granular. Mouth pyriform, with a minute internal denticle ? and rarely a median suboral avicularium, with a long spatulate mandible, pointing directly downwards.

Habitat.—Off Bahia, 10 to 20 fathoms.

[The only specimen of this apparently undescribed species is a small dead fragment, containing no chitinous parts, and otherwise in bad condition, so that it is doubtful whether there really is an internal denticle; but the median descending avicularium, of which I cannot see more than one in the entire specimen, renders it almost certain that the form belongs to *Smittia*, or is closely allied to it.]

(*b*) Unilaminar, erect or crustaceous, unattached (hemescharan).

(2) *Smittia smittiana*, n. sp. (Pl. XVII. fig. 3).

Character.—Zoarium quite unattached, foliaceous, expanded. Zoœcia quincuncial, elongated oval, or fusiform. Surface uniformly punctured, epitheca thick and white. Primary orifice suborbicular, rather wider than high, with two lateral notches in the lower lip; secondary clithridiate, peristome much raised all round, but especially on the sides; a median oral avicularium of circular form, with a short duck-bill shaped mandible, deeply seated behind which is an internal rather broad denticle. Oœcium prominent, hemispherical, with an oval or rather reniform circumscribed area in front, within which are usually five converging more or less triangular openings, the borders of which are not thickened. The anterior border of the oœcial mouth straight, joining the lateral elevations of the peristome on each side. On the dorsal aspect, the zoœcia are barrel-shaped and imperforate, and the texture of the hind wall is very coarse and thick. Zoœcia from 0″·02 to ·03 wide × ·04 to ·06 long.

Habitat.—Station 320, lat. 37° 17′ S., long. 53° 52′ W., 600 fathoms, green sand.

This beautiful form differs from *Smittia landsborovii*, Johnst.: 1, in the form of the zoœcia, and in their not being separated by septal ridges; 2, in the size and form of the suboral avicularium; 3, and more especially in the primary conformation of the orifice, which in that species has a prominent tooth within the lower lip, with a minute denticle on either side of it (Hincks), whilst in *Smittia smittiana* the lower lip presents two small lateral notches separated by a wide portion of the border, which in a subsequent stage of development appears to be reduced to a comparatively narrow hammer-shaped denticle.

(3) *Smittia marsupialis*, n. sp. (Pl. XVIII. fig. 1).

Character.—Zoœcia serial, quadrilateral, flattened in front, with the oral portion somewhat raised; wall punctured. Orifice, at first suborbicular, entire, with a broad internal median denticle, and two smaller points on the sides; afterwards the peristome

becomes very much elevated on the sides, forming a wide spout-like subtubular projection. Occasionally a small avicularium on one side at the upper part of the front with an acute triangular mandible pointing upwards and inwards. The fertile cells about half the size of the sterile ones, and seated on the front of the larger cells; the oœcium, of small size and globular in form, is recumbent, and leans over to one side, so as not to interfere with the orifice of the supporting zoœcium; its surface is finely punctured, and the anterior lip of the opening much thickened and projecting.

Habitat.—Off Honoruru, Sandwich Islands, 20 to 40 fathoms. Station 313, lat. 52° 20′ S., long. 67° 39′ W., 55 fathoms, sand.

The peculiar situation of the fertile cells on the front of one of the sterile kind is a very remarkable feature; the mouth of these smaller zoœcia is formed exactly in the same way as in the others.

(4) *Smittia transversa* (Pl. XVIII. fig. 7).

Character.—Zoarium expanded, foliaceous. Zoœcia elongated, pyriform, truncate below, rather flattened in front. Surface finely granular, a row of pores round the entire border. Mouth orbicular, a small internal median denticle, and on the lower border in front a small immersed avicularium of an oval form and placed transversely. Dorsal surface entire, porcellanous, wall thick. Interzoœcial pores, 10 to 12, very minute.

Habitat.—Station 163A, off Twofold Bay, 150 fathoms, green mud.

Bears some resemblance to *Lepralia reticulata* in one or other of its varieties; and in the transverse position of the suboral avicularium is like *Smittia affinis*, Hincks.

(5) *Smittia marionensis*, Busk (Pl. XVIII. fig. 6).

Lepralia marionensis, Bk., Brit. Mus. Cat. p. 67, pl. xcvi. figs. 1 and 2.

Character.—Zoarium foliaceous, expanded, flexuose, unattached. Zoœcia ovate, ventricose, no septal ridges; wall thin, punctured, punctures wide apart. Primary orifice suborbicular, with a small almost circular median avicularium on the lower border, and a conical much reclined internal denticle; peristome thickened and elevated; afterwards forming an elevated lip on each side, which is continued around a large suboral avicularium with a duck-bill shaped obtuse mandible pointing vertically downwards. Oœcium distinct, hemispherical, surface smooth, with several more or less triangular converging pores on the front; each pore surrounded with a thickened border. Posterior surface entire, opaque, almost porcellanous.

Habitat.—Prince Edward Island, 80 to 150 fathoms. Station 149D, Royal Sound, Kerguelen Island, 28 fathoms, volcanic mud.

[Marion Island, 80 fathoms, Hooker].

(6) *Smittia jacobensis*, n. sp. (Pl. XIX. fig. 7).

Character.—Zoœcia subrhomboidal; in older parts quite immersed, depressed in front, with the oral region much elevated and subtubular. Surface punctured. Primary orifice subcoarctate or almost orbicular, with an extremely minute spoon-shaped denticle behind the middle of the entire lower lip; two delicate marginal spines above; the peristome soon becomes thickened, at first especially on the sides and in front, with a decided median sinus. The thickening and elevation of the sides of the raised peristome rapidly increase till the prominences on either side meet in the middle, and form a broad bridge in front of the orifice; below the orifice within the abutments of the bridge is developed a sessile median avicularium with a rounded mandible directed downwards. Oœcia small, deeply immersed, with a kidney-shaped perforated area on the front.

Habitat.—Porto Praya, St. Iago, Cape Verde Islands, 100 to 120 fathoms. Off Marion Island, 50 to 75 fathoms. (Parasitic on a *Salicornaria*).

The conformation of the orifice and suboral avicularium, though in some respects like that in *Smittia marionensis* and perhaps *Smittia landsborovii*, differs in the circumstance that in those species the two sides of the elevated peristome never coalesce so as to form a bridge; in *Smittia jacobensis* also the peristome is not continued round the avicularium as it is in those two species, and generally speaking in the whole of the so termed genus *Smittia*, to which, nevertheless, so far as the oral structure is concerned, the present species would seem to belong.

(*c*) Adnate (lepralian).

(7) *Smittia oratavensis*, n. sp. (Pl. XXII. fig. 1).

(?) *Smittia marmorea*, Hincks, Ann. and Mag. Nat. Hist., ser. 4, vol. xx. p. 214, 1877; Brit. Mar. Polyz., vol. i. p. 350, pl. xxxvi. figs. 3–5.

Character.—Zoœcia immersed at the base, erect above. Orifice clithridiate, or widely notched in front; peristome raised, not thickened, a broad denticle within. Surface rugose, finely punctured, with a row of larger marginal pores. An elongated, immersed avicularium on the middle of the front; mandible slender, pointing vertically downwards. Oœcia recumbent, deeply immersed, surface punctured.

Habitat.—Station 75, lat. 38° 38′ N., long. 28° 28′ W., 450 fathoms, volcanic mud. [Port of Orotava, Teneriffe, W.K.P.; Cornwall and Guernsey, ? Hincks.]

This form, of which many years since I received specimens from the Port of Orotava, through Mr. W. K. Parker, appears to correspond very closely with Mr. Hincks' British

species; the only difference between them is the apparently smaller size of the anterior avicularium. Should the two turn out to be identical, Mr. Hincks' name must, of course, be adopted.

(8) *Smittia stigmatophora*, n. sp. (Pl. XXII. fig. 6).

Character.—Zoœcia completely immersed, flattened in front, irregularly quincuncial; surface shining, with closely placed large circular punctures, which are larger round the border. Primary orifice arched, dentate; secondary clithridiate with a small avicularium with spatulate mandible just within the lower lip, and in front of the hammer-shaped denticle. Oœcia inconspicuous, completely immersed; surface granular and presenting a crescentic or reniform, punctured stigma in front.

Habitat.—Station 315, lat. 51° 40′ S., long. 57° 50′ W., 12 fathoms, sand and gravel (on shells).

In some respects resembling *Lepralia* (*Smittia*) *cheilostoma*, Manzoni, as well as *Lepralia* (*Smittia*) *bella*, Busk, it differs from the former in having an avicularium within the lower border of the orifice; in the deeply immersed oœcium with its peculiar stigma, resembling that in many Australian Retepores, as well as in the absence of a raised septum, or even of a sulcus between the zoœcia. It has a dull purplish colour, and is very closely attached to the shell upon which it is growing, and the posterior wall of the zoœcia in a small detached fragment is deficient.

(9) *Smittia graciosa* (Pl. XXII. fig. 13).

? *Porella concinna*, var. *β. gracilis*, Hincks, *loc. cit.*, p. 324, pl. xlvi. fig. 9.

Character.—Zoœcia elongate, oval, attenuated and somewhat raised towards the orifice. Secondary orifice clithridiate, enclosing within the lower border a small circular avicularium with a spatulate mandible, and behind this an internal denticle. Peristome thin, two oral spines above but only in the youngest cells. Surface punctured, the punctures rather distant and uniformly distributed.

Habitat.—Station 148, lat. 46° 47′ S., long. 51° 37′ E., 210 fathoms, hard ground, gravel and shells.

This form appears to bear a strong resemblance to that described by Mr. Hincks. It differs, however, to judge from his figure, in the form of the zoœcia, which in Mr. Hincks' species are apparently longer and slenderer and separated by raised septa, which are entirely wanting in the present form. Notwithstanding this, it is by no means clear that the two are not identical; if so, I should nevertheless be inclined to refer neither to *Porella concinna*, an essential character of which, as indeed is pointed out by Mr. Hincks, is the presence of a row of marginal pores, of which there is no trace either in *Porella concinna β*, or in the present form.

7. *Mucronella*, Hincks.

Berenicea (pars), Fleming.
Lepralia (pars), Johnst., Bk. ; &c.
Escharella, Gray (sp.), Smitt.
Discopora (pars), Smitt, Gray.
Mucronella, Hincks, Brit. Mar. Polyz.
Eschara (sp.), Bk.

Character.—Zoarium erect and bi- or uni-laminar ; or crustaceous and unattached ; or adnate. Orifice mucronate in front.

(*a*) Bilaminar (escharan).

(1) *Mucronella contorta*, Busk (Pl. XX. fig. 9).

Eschara contorta, Bk., Brit. Mus. Cat. I. p. 89, pl. cviii. figs. 1, 2, 3.

Character.—Zoarium thick, lobate, undulate. Zoœcia almost hemispherical in front, surface closely and widely punctate. Mouth orbicular, lower border mucronate. On many of the zoœcia an avicularium with a duck-bill shaped mandible on one or both sides of the orifice, and sometimes a small one quite within its border on one side.

Habitat.—Simon's Bay, Cape of Good Hope.

[Algoa Bay ; Natal.]

The internal avicularium varies a good deal in size ; it was overlooked when the description of the species in the Brit. Mus. Cat. was drawn up, and is not always present nor visible.

(2) *Mucronella pyriformis*, n. sp. (Pl. XX. fig. 5).

Character.—Zoarium of small size, lobate. Zoœcia pyriform, immersed but separated by deep sulci. On the front a thick rounded elevated ridge surrounds the orifice, and the two sides joining, is continued as a tumid elevation to the bottom. Mouth suborbicular, apiculate in front, with a wide rounded internal denticle ; no frontal avicularium.

Habitat.—Station 161, off Port Philip, 33 fathoms, sand.

The above characters are only exhibited distinctly in the younger parts of the zoarium. In most parts the zoœcia are much overgrown so that the surface becomes almost level, the rounded orifices with the thickened annular peristome slightly projecting. And in this state the small apiculate mucro is altogether wanting. Sometimes the zoœcia assume a more or less ovate form. The species is very doubtfully referred to *Mucronella*.

(*b*) Unilaminar, erect or crustaceous unattached (hemescharan).

(3) *Mucronella quadrata*, n. sp. (Pl. XVIII. fig. 5, and Pl. XVII. fig. 8).

Character.—Zoarium closely investing a branch of coral but not attached to its surface; of a white colour. Zoœcia very uniformly serial, rectangular and almost square, separated by very thin septal ridges. Surface convex, uniformly and closely punctate, wall thick, opaque. Orifice orbicular, mucronate, with an acute, curved, internal articular denticle on each side. Occasionally, but very rarely, a large intercalated immersed avicularium with a spoon-bill shaped mandible. Dorsal surface entire, smooth, porcellanous.

Habitat.—Station 172, off Nukalofa, Tongatabu, 18 fathoms, coral mud.

(4) *Mucronella delicatula*, n. sp. (Pl. XVIII. fig. 2).

Character.—Zoarium tubular, free. Zoœcia serial, subquadrangular in front, quite square behind, separated by very thin septal ridges. Anterior surface flattened, surface finely granular with a single row of pores round the border. Orifice orbicular, peristome thin, entire; a rather wide expanded median mucro, and a very minute, rather obtuse, articular tooth on each side within the border of the orifice. On some of the zoœcia, a sessile avicularium on one side of the body with a triangular mandible pointing downwards. Oœcia unknown.

Habitat.—Off Honoruru, Sandwich Islands, 20 to 40 fathoms.

The orifice in this species is truly orbicular in all stages of growth, and the peristome does not appear to undergo any secondary development. The mucro though within the border of the orifice, is in front of the operculum. In the figure the lateral articular denticles are shown rather too clearly, as in many instances they are scarcely perceptible.

(5) *Mucronella rostrigera*, n. sp. (Pl. XIX. fig. 2).

Character.—Zoarium rather thick, surrounding an *Echinus*-spine, white, and dull; the wall appearing to be formed of excessively fine, interlaced fibres. Zoœcia ovate, distinct, moderately convex. Orifice subtrifoliate, the peristome being raised into a broad tooth on either side, and into a strong conical mucro in front which eventually becomes rostriform and supports a rounded avicularium on the summit. Oœcia subglobose, partially immersed; surface entire with a faintly marked oval elevation on each side below. Operculum nearly circular, 0″·004.

Habitat.—Prince Edward Island, 80 to 150 fathoms.

The rostriform avicularium in this case differs essentially from that in the preceding species, in its being apparently simply a development of an original true mucro and not a subsequent growth altogether below the orifice. The minute structure of the ectocyst is very remarkable. At first sight, with a magnifying power of about 50 diameters, the appearance is something like that of "crackling" china, which is apparently due to the wall being constituted of exceedingly fine calcareous fibres, forming a sort of felted texture not unlike that of a spider's cocoon.

(6) *Mucronella bisinuata*, Smitt (sp.) (Pl. XIX. fig. 5).

Escharella bisinuata, Smitt, Florid. Bryoz., p. 59, pl. xii. fig. 229.

Character.—Zoarium thick, coarse looking, expanded. Zoœcia subserial, irregularly quincuncial, broadly ovate or subrhomboidal in front, oblong posteriorly; the wall is seen to be punctured when the thick epitheca is removed. Orifice coarctate, lower lip straight, with two lateral incisions. Many of the zoœcia with four avicularia, two on the sides near the orifice and two lower down on the front; (mandibles acute, slightly curved and pointed in various directions). Sometimes only one avicularium and occasionally none, especially in the zoœcia towards the growing edge. On the dorsal aspect, the wall is thin, smooth, slightly convex and presents a rounded oval or reniform opening with a slightly raised border. Oœcia inapparent. Zoœcia about 0″·02 wide. Operculum 0″·012 × ·01.

Habitat.—Station 190, lat. 8° 56′ S., long. 136° 5′ E., 49 fathoms, green mud.

[Gulf of Florida, 9 to 19 fathoms, Pourtalès.]

There appears no reason to distinguish this form from that described by Prof. Smitt, the only differences between them being that in the present the zoœcia in front are not so decidedly rectangular and that the number of avicularia is occasionally much greater, Prof. Smitt ascribing only one to his species, whilst in the present the number is very often four to each zoœcium. I have been unable to discern any oœcia in the Challenger specimens, and consequently no character derived from them is afforded. The double notching of the lower lip is a striking character possessed in common by the two forms, and as it is of extremely rare occurrence among the Polyzoa, must be held as of great importance, at any rate as a specific character.

(7) *Mucronella castanea*, n. sp. (Pl. XIX. fig. 6).

Character.—Zoarium flat, expanded. Zoœcia rhomboidal or subovate, wide, slightly convex in front; surface shining, uneven; wall punctured. Orifice coarctate; lower lip bluntly mucronate; peristome neither thickened, nor raised; usually an avicularium on one or both sides of the orifice in front, varying much in size, from 0″·005 to ·02 in length;

in the larger ones the mandible is acute, sword-shaped, pointing directly upwards; in the smaller, rounded. Œcium globose, very prominent, finely punctured all over, and sometimes, having at the lower part, in front, a rounded papillary eminence, supporting a minute avicularium. Dorsal wall entire. Zoœcia about 0″·02 wide. Orifice 0″·01 wide.

Habitat.—Off Bahia, 10 to 20 fathoms. Station 122, lat. 9° 5′ S., long. 34° 50′ W., 32 to 400 fathoms, red mud.

It is of a deep bright brown colour. The description is taken from specimens that have been boiled in caustic soda. In the natural state the surface is covered with a uniform chitinous epitheca, to which the colour is mainly due, and which conceals the sculpture of the surface. It occurs in the collection only in broken fragments which show no sign of its having been attached to anything. The posterior surface is smooth and divided into convex, oblong, imperforate spaces, corresponding to the outlines of the zoœcia.

In some respects closely resembling *Escharella lamellosa*, Smitt; the differences between that arctic form and the present are amply sufficient to distinguish them. Amongst these may be noted (1) that in *Escharella lamellosa* the wall of the zoœcium is entire and imperforate except a row of elongated punctures round the border, whilst in *Mucronella castanea* the surface is closely punctate all over; (2) in *Escharella lamellosa* there are normally 3 to 5 oral spines above, and the surface of the oœcium is smooth, and presents three round pores in front, and usually an ovate stigma on each side below, whilst in *Mucronella castanea* the surface of the oœcium is very finely and beautifully punctate all over, and is furnished with a small circular papilliform avicularium on each side below.

What the general habit of the zoarium may be cannot be determined from the fragmentary specimens in the collection.

(8) *Mucronella magnifica*, n. sp. (Pl. XVIII. fig. 3).

Character.—Zoarium expanded, suberect. Zoœcia subovate, or rhomboidal, or irregularly hexagonal behind; convex in front and behind; covered with a very thin dark brown epitheca. Anterior wall very thick, closely punctate; posterior thin, transversely wrinkled with from 1 to 4 or more rounded perforations, from which, in the upper part, radical tubes issue; four lateral interzoœcial plates. Orifice orbicular with a broad central mucro on the lower border and two lateral acute points (not internal denticles); four articulated marginal spines above. A conical, rostral projection in front, immediately below the orifice, supporting on one side of its summit an avicularium, with a broad duck-bill shaped mandible. On one or both sides of the orifice but not close to it is a large avicularium, with an elongated, duck-bill shaped mandible, pointing obliquely upwards. Oœcium large, lofty, and very prominent, the front prolonged downwards

into a sort of lip overhanging the orifice. Surface very closely and finely punctured. Zoœcia about 0″·025 to ·03 wide. Orifice 0″·015. Operculum semicircular 0″01 × ·008.

Habitat.—Off Honoruru, Sandwich Islands, 20 to 40 fathoms.

From its size, colour, and conformation this form is one of the most magnificent of the Polyzoa. Although of such large dimensions, it is covered with an extremely thin and fugitive epitheca of a deep purplish-brown hue, (of a much deeper tint than that of *Mucronella castanea*), but the colour is in great part due to that of the polypides themselves. Amongst its most striking and conspicuous characters is the oœcium, of a beautiful pearly aspect and sculptured all over, except the lip-like prolongation inferiorly, and furnished with minute hexagonal pores. The marginal spines are represented, in the specimens observed, only by what appears to be the basal joint; they are probably when present of large size. From the figure it might be supposed that the lateral projections, at the lower part of the orifice, were internal articular denticles, but in reality they as well as the central broad mucro are, *ab origine*, processes of the thin peristome itself.

(*c*) Adnate (lepralian).

(9) *Mucronella* (*Phylactella* ?) *canalifera*, n. sp. (Pl. XXII. fig. 2).

Lepralia mangnevilla, Bk., Zoophyt., Quart. Journ. Micr. Sci., N. S., vol. xiii. p. 284, pl. xxxi. fig. 5 (*nec* Audouin).

Character.—Zoœcia erect, very distinct, ventricose, surface varnished and very finely punctate or frosted. Orifice suborbicular; peristome produced in front into a wide spout-like process; six long, tapering, oral spines above and on the sides. Oœcia small, recumbent, not punctured.

Habitat.—Station 75, lat. 38° 38′ N., long. 28° 28′ W., 450 fathoms, sand.

[Madeira, J. Y. J].

This form differs from *Lepralia* (*Phylactella*) *labrosa* in the absence of an internal denticle, and from *Lepralia* (*Phylactella*) *collaris* in the presence of the oral spines and the absence of puncturation on the oœcium.

(10) *Mucronella tricuspis*, Hincks (Pl. XXII. fig. 3).

Mucronella tricuspis, Hincks, Ann. and Mag. Nat. Hist., ser. 5, vol. viii., 1881, p. 125, pl. iii. fig. 1.

Character.—Zoarium adnate. Zoœcia disposed quincuncially but more or less in linear series, running in different directions; deeply immersed, except at the growing edge, with the oral portion produced. Primary orifice transversely elliptical,

with a bluntly mucronate lower border; afterwards the peristome rises in front into a rather slender median mucro, usually with a shorter one on each side or sometimes two. Three or four non-articulated oral spines above. A projecting avicularium on one or both sides of the front low down, with an acutely pointed mandible pointing upwards and outwards; surface granular. Oœcium rounded, subimmersed. Surface granular.

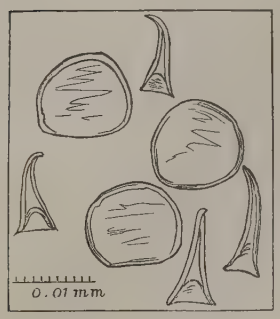


Fig. 45.—*Mucronella tricuspis.*

Habitat.—Station 315, lat. 51° 40′ S., long. 57° 50′ W., 12 fathoms, sand and gravel (on *Fucus*). Simon's Bay, Cape of Good Hope. Prince Edward Island, 80 to 150 fathoms.

[Tierra del Fuego and Chiloe Archipelago, Darwin; Curtis Island, Bass Strait, Hincks.]

On the Fuegian specimens the avicularia are sometimes much larger, but the mandibles present the same forked basal end.

The characters of *Mucronella tricuspis* are seen with great difficulty except at the growing border. The accompanying woodcut represents the chitinous organs, which are quite sufficient for its identification.

(11) *Mucronella simplicissima*, n. sp. ? (Pl. XXII. fig. 5).

Character.—Zoœcia very distinct, fusiform, subtubular, and curved forwards above; surface smooth, entire, porcellanous. Orifice orbicular, with a small pointed mucro in front; peristome very slightly thickened.

Habitat.—Station 161, off Port Philip, 33 fathoms; sand (on dead shells).

Probably merely an adnate variety of *Mucronella pyriformis.*

(12) *Mucronella ventricosa*, var. *multispinata*, Busk (Pl. XXII. fig. 11).

Lepralia multispinata, Bk., Quart. Journ. Micr. Sci., N. S., vol. i. p. 77, pl. xxxii. figs. 5, 6, 1861.
? *Mucronella peachii*, var. *β octodentata*, Hincks, Brit. Mar. Polyz., p. 361, pl. li. fig. 2.

Character.—Zoœcia ventricose, immersed below, convex in front and much raised, almost tubular above; surface granular, with a row of minute distant pores near the border. Orifice subclithridiate, mucronate in the young state; peristome in mature zoœcia thick, much raised and projecting in front, with six to eight erect, long, and strong spines on the sides and behind; but usually broken off. A broad denticle some distance within the orifice. Oœcia prominent, small, globular; surface granular.

Habitat.—Station 148, lat. 46° 47′ S., long. 51° 37′ E., 210 fathoms, hard ground, gravel and shells. Prince Edward Island, 80 to 150 fathoms.

The growth, which is of a most beautiful pearly aspect, completely covers the valve of a *Terebratula*, the zoœcia being disposed in parallel linear series, radiating irregularly from the centre.

The only difference of any importance between this form and the typical *Lepralia* (*Mucronella*) *ventricosa* is in its having eight oral spines instead of four. In this respect it corresponds with Mr. Hincks' *Lepralia* (*Mucronella*) *peachii* var. *β octodentata* with which indeed it is in all probability identical. But that it is a form of *Mucronella ventricosa* and not of *Mucronella peachii* is obvious from the other characters, amongst which perhaps the most important is the great width of the internal denticle. The great convexity also of the zoœcia and the deep sulci between them, together with the forward position of the oœcium and the peculiar radiate sculpturing of the surface of the zoœcia and their large size, seem to be sufficient to show that the present form should be referred to *Mucronella ventricosa*. One remarkable feature presented by it is the extreme diversity in size of the zoœcia; the central ones being perhaps less than half the size of those at some distance from the centre of the colony. It also exhibits in a very marked degree the great changes undergone at different stages by the peristome, which, in *Mucronella ventricosa*, as Dr. Manzoni remarks, "e tanto più largo et calloso, quanto più la cellula e avvanzata in età."

8. *Aspidostoma*, Hincks.

Eschara (sp.), Bk.

Character.—Zoarium dimorphous, uni- or bi-laminar; erect, solid, rising from a contracted calcareous base, or expanded and foliaceous. Zoœcia with the front depressed in the centre and the sides tumid. Mouth quite at the summit of the depressed area, concealed under the tumid border, on which above the mouth is a penthouse-like, usually bifid projection. The mouth arched above, straight below, and protected in front by a broad shield-like plate or mucro which is continued downwards for some distance within the zoœcium.

Aspidostoma giganteum, Busk, sp. (Pl. XXXIII. fig. 3).

Eschara gigantea, Bk., Brit. Mus. Cat., vol. i. p. 91, pl. cxix. fig. 3.
Aspidostoma crassum, Hincks, Contrib. Ann. and Mag. Nat. Hist., ser. 5, vol. vii. p. 47, pl. x. figs. 6, 6*a*, 1881.

Character.—Zoarium erect, bi- or uni-laminar. Zoœcia broadly pyriform or hexagonal, very convex or tumid in front, depressed in the centre. Surface granular, walls very thick and massive, rounded on the sides; separated by deep sulci. Mouth quite at the summit of the depressed area concealed under the tumid border, crescentic

or arched above, straight below, protected in front by a broad mucronate plate. Above the mouth a penthouse-like projection, usually bifid but sometimes continuous.

Habitat.—Station 135c, off Nightingale Island, Tristan da Cunha, 110 to 150 fathoms.

[South Patagonia, Darwin; between Patagonia and the Falkland Islands, Captain Warren, Hincks.]

I have followed Mr. Hincks in placing this very peculiar form under a distinct genus, quite agreeing with him that it is entitled to take that rank among the Escharidæ.

Mr. Hincks (*loc. cit.*) describes the zoarium as composed of two layers, and this was the condition in the form described by me in the Brit. Mus. Cat. under the name of *Eschara gigantea;* but the few fragments contained in the Challenger Collection exhibit only a single layer, and from the peculiar aspect of the dorsal surface it is obvious that when the layers are double, they are not inseparably united as in *Eschara*, but merely in apposition, so that in fact *Aspidostoma* should be regarded as belonging to the *Hemescharine* rather than to the *Escharine* type, or that the two layers are formed simply by reduplication of the lamina upon itself.

Mr. Hincks states that "leaning against the side of many of the cells, a little below the upper extremity, there is an avicularium, with a very short, broad, subtriangular mandible directed upwards"; and also that the "oœcia are elongate, much depressed, shield-like and granulated."

He also says that the broad shield-like plate in front of the mouth, or the "projecting lower lip" noticed in the Brit. Mus. Cat., is continued downwards for some distance within the cavity; and that attached to the inner surface of the plate, on a level with the margin of the orifice, is a semicircular membrano-calcareous frame into which the operculum fits.

§ 2. Primary mouth notched or sinuated below.

9. *Schizoporella*, Hincks.

Lepralia, (pars), Johnst., Busk, &c.
Escharina (pars), d'Orb.
Reptoporina (pars), d'Orb.
Escharella, subgenus *Herentia* (pars), Smitt, Krit. Förteckn.
Mollia (pars), Smitt, *Ibid.*
Schizoporella, Hincks, Brit. Mar. Polyz.

Character.—Zoarium erect and bi- or uni-laminar; or crustaceous and unattached; or adnate. Lower lip with a median notch. Operculum pedunculate, or contracted below.

(*a*) Bilaminar (escharan).

(1) *Schizoporella furcata*, n. sp. (Pl. XXI. fig. 5).

Character.—Zoarium (small), furcate; branches subcylindrical, tapering (0″·05 to ·055 wide). Zoœcia immersed, oblong, separated by thin septa. Surface punctate. Mouth semicircular, with a wide shallow sinus in the lower lip. Sometimes, but rarely, a very small avicularium on one shoulder. Oœcia lofty, convex, and prominent in front, but deeply imbedded in the superjacent zoœcium; surface finely granular; with an arched line on either side, the two converging so as to form a slight keel on the front.

Habitat.—Off Honoruru, Sandwich Islands, 20 to 40 fathoms.

There is sometimes a small membranous web filling up the angles of the branches of the zoarium.

(*b*) Unilaminar (hemescharan).

(2) *Schizoporella nivea*, n. sp. (Pl. XVII. fig. 1).

Character.—Zoarium expanded, foliaceous, free, of a milk-white colour. Zoœcia quincuncial, but serial; quadrangular, slightly convex in front and separated by fine septal ridges; surface uniformly punctured. Orifice suborbicular, slightly sinuated below. A small rounded papillary elevation at each upper angle, not apparently avicularian, but closed. Oœcium globose, large, punctured uniformly with the wall of the zoœcium. The dorsal surface of the zoœcia entire and smooth.

Zoœcia 0″·025; orifice 0″·0075 wide.

Habitat.—Station 142, lat. 35° 4′ S., long. 18° 37′ E., 150 fathoms, green sand.

(3) *Schizoporella longispinata*, n. sp. (Pl. XVII. fig. 2).

Character.—Zoarium small, partially attached by calcareous matter but mostly free. Zoœcia quincuncial, completely immersed, but convex in front, broadly ovate; at the growing margin subventricose. Surface irregularly verrucose. Orifice orbicular, emarginate, unchanging. Peristome rather thick, with six very long, acute, usually terete but sometimes compressed, articulated and jointed oral spines; sometimes bifid at the point. An erect, acutely pointed avicularium on one side of the orifice, with an acute slender mandible pointing directly upwards. Oœcium globose, smooth and polished, with a sinus or notch on each side at the bottom, the anterior border of its opening descending so as to completely conceal the opening, and the whole oœcium

stands behind and free of the zoœcial orifice. Two or sometimes four of the marginal spines persist in front of the oœcium. On the dorsal aspect the zoœcia are irregularly hexagonal and convex, with a small circular pore in the centre of each. Zoœcia about 0″·02 wide; orifice 0″·005.

Habitat.—Station 312, lat. 53° 37′ S., long. 70° 56′ W., 10 to 15 fathoms, blue mud.

The chief peculiarities of this form are :—1. The great length of the oral spines on the young zoœcia and the curious structure presented by some of them, which are more or less compressed, whilst the majority are cylindrical or terete; both appear to be indistinctly jointed, and many, instead of a single long and acute point, have a small terminal joint supporting two minute conical points. 2. Besides the central pore on the dorsal wall, many of the zoœcia present hollow conical elevations, by which, as it would seem, the very scanty calcareous adhesions are formed.

(4) *Schizoporella auriculata* (?), Hassall, var. *alba*, nov. (Pl. XIX. fig. 1).

Character.—Zoarium delicate, thin, white; zoœcia rhomboid or subovate, deeply immersed, no septa; disposed in lines radiating from the centre. Surface vitreous, granular, very obscurely punctured round the border. Orifice orbicular, emarginate, with four superior marginal spines. A prominent conical rostrum immediately below the orifice, with a circular avicularium on the summit. Oœcia about half immersed, lofty, convex in the front which presents a circular circumscribed area including numerous punctures of unequal size and more or less angular in shape.

Habitat.—Station 135c, off Nightingale Island, 110 to 150 fathoms, and (135a) off Inaccessible Island, Tristan da Cunha, 75 to 90 fathoms, hard ground, shells, gravel.

Probably closely allied to *Schizoporella auriculata*, but differing in the absence of any raised septal line between the zoœcia, and it may be added in the white colour, and more particularly also in the shape of the operculum.

(5) *Schizoporella jacksoniensis*, n. sp. (Pl. XIX. fig. 3).

Character.—Zoarium rather thick. Zoœcia broadly ovate, very convex, with a distinct raised line round the border. Surface reticulato-punctate. Orifice emarginate, peristome thickened, smooth, slightly raised above (not in front). A rather large sessile avicularium on one side of many of the zoœcia with an acute triangular mandible, directed upwards. Oœcia inapparent.

Habitat.—Station 163b, off Port Jackson, 35 fathoms, hard ground (parasitic round a Sertularian).

(6) *Schizoporella tenuis*, n. sp. (Pl. XX. fig. 10).

Character.—Zoarium very delicate, expanded, unattached. Zoœcia quadrangular, flattened or depressed in front, separated by thin raised septal ridges; surface punctate. Mouth orbicular, with a wide shallow sinus in front, and on the sides a minute articular notch. Peristome thin, slightly raised in front. A minute round or oval, quite immersed avicularium at each intersection of the vertical and transverse interzoœcial septa. Oœcia 0 ?

Habitat.—Off Honoruru, Sandwich Islands, 20 to 40 fathoms. Simon's Bay, Cape of Good Hope.

At first sight bearing a general resemblance to many of the various Lepralioid forms, known as *Lepralia* (*Schizoporella*, Hincks) *unicornis*, *ansata*, &c., the present species appears to be distinguished (1) by the perfectly flat or concave anterior surface of the cells; (2) by the form of the mouth, which, instead of being semicircular with an emarginate lower lip, is more of the rounded clithridiate form, assigned by Prof. Smitt to his hippothoan species; (3) by the circumstance that the lateral avicularia are placed quite in the angles formed by the transverse and longitudinal interzoœcial septa, and that they are of much smaller size or more deeply immersed than in any of the forms placed under *Lepralia unicornis* or *Lepralia ansata*, and have a semicircular, extremely minute mandible. With respect to these avicularia, it may be mentioned that they are fully formed, as it would seem, before the completion of the zoœcia themselves, as may be seen at the growing edge, so that they might perhaps be described as belonging more to the general zoarial whole than to any particular zoœcial compartment of it.

(*c*) Adnate (lepralian).

(7) *Schizoporella elegans*, d'Orbigny (Pl. XXII. fig. 8).

? *Escharina elegans*, d'Orb; Voy. en Amér. Mérid.
? *Lepralia squamoidea*, Reuss, Oberoligocäns, p. 19, pl. xv. fig. 5, and Bryoz. des Sept. p. 56, pl. vii. fig. 3; Manzoni, Castracaro, p. 29, pl. iv. fig. 46.

Habitat.—Station 142, lat. 35° 4′ S., long. 18° 37′ E., 150 fathoms, green sand (parasitic on an *Adeonella*). Station 148, lat. 46° 47′ S., long. 51° 37′ E., 210 to 500 fathoms, hard ground, gravel and shells.

(8) *Schizoporella marsupifera*, n. sp. (Pl. XXII. fig. 14).

Character.—Zoœcia irregularly hexagonal, slightly convex in front; surface pearly, glistening, very finely granular; disposed quincuncially and separated by raised septa. Orifice orbicular, emarginate, peristome thin, furnished very rarely with two long oral

spines behind. A prominent rostral pouch, supporting a small avicularium on the front of the zoœcium below the orifice. Oœcia very prominent, globose, rather wider than high; surface granular with a faintly marked, beaded border.

Habitat.—Marion Island, 50 to 75 fathoms (on *Fucus*). Station 167, lat. 39° 32′ S., long. 171° 48′ E., 150 fathoms, blue mud.

The oral spines remain, apparently, only on the youngest zoœcia at the growing edge of the colony.

(9) *Schizoporella cecilii*, Audouin (sp.).

Flustra cecilii, Aud., Expl. i. p. 239; Savigny, Egypte, pl. viii. fig. 3.
Lepralia cecilii, Bk., Quart. Journ. Micr. Soc., vol. v. p. 173, pl. xv. figs. 6, 7; Macgillivray.
Schizoporella cecilii, Hincks, Brit. Mar. Polyz., p. 269.

Habitat.—Station 161, off Port Philip, 33 fathoms, sand.

(10) *Schizoporella circinata*, Macgillivray (sp.).

Lepralia circinata, Macgilliv., Nat. Hist. Vict. Dec. iv., p. 21, pl. xxxv. fig. 1.

Character.—Zoarium adnate (on coral). Zoœcia broad, ovate, convex in front, no interzoœcial septa. Surface in the middle prominent, quite smooth, outside of which it is widely punctate or pitted. Oral orifice semicircular, with a perfectly straight lower border with a median narrow notch or fissure which widens out below and lodges a moveable process connected with the operculum; 6 to 8 long articulated oral spines above. Oœcium lofty, prominent, glassy, smooth. Sometimes a long channel-like retentive avicularium on the front, the mandible pointing downwards.

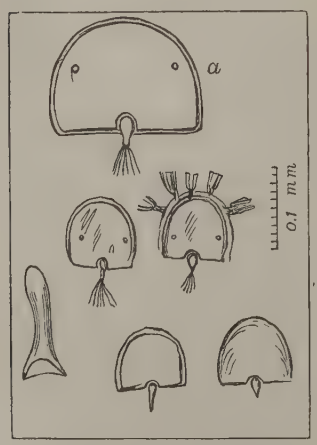


Fig. 46.—*Schizoporella circinata.*
a, Operculum of Schizoporella cecilii.

Habitat.—Station 135A, off Inaccessible Island, Tristan da Cunha, 75 to 90 fathoms, hard ground, shells, gravel.

The very peculiar conformation of the operculum in this species, exactly resembling that of *Schizoporella cecilii* in miniature, affords at once a distinctive character, as I am unacquainted with any other form with a similar kind of operculum. What is the nature of the curious little moveable appendage jointed to the operculum, in this and the preceding species, is by no means clear; but it would seem that a minute fasciculus of muscular fibres is connected with its lower part. The accompanying woodcut shows the characters above described, as well as the great difference in size of the operculum (*a*) of *Schizoporella cecilii*.

(11) *Schizoporella triangula*, Hincks.

Schizoporella triangula, Hincks, Contrib. vi., Ann. and Mag. Nat. Hist., ser. 5, vol. viii. p. 12, pl. ii. figs. 4, 4*a*, 1881.

Character.—Zoarium adnate or partially free (on sponge), sometimes with superposed layers. Zoœcia disposed irregularly or in linear series and separated by raised septa; subquadrangular or irregular in outline; surface nodulose (sometimes reticulato-punctate); of two kinds, barren and fertile or oœcial. Orifice of barren cells subtriangular, arched above and much contracted or pointed below, with a small articular denticle on each side near the bottom; of the fertile or oœcial cells, much larger, elongated transversely and arched above, with a slightly sinuated entire lower border. A small avicularium with an acute triangular mandible close to the orifice; and on the front a vertical elongated avicularium with a slender spear-shaped mandible slightly dilated at the point, upon which is a minute obtuse mucro. Opercula of two kinds corresponding to the two forms of orifice, both thick and solid, and marked with fine curved transverse wrinkles.

Habitat.—Station 162, off East Moncœur Island, Bass Strait, 38 fathoms, sand and shells. (?) Station 151, off Heard Island, 75 fathoms, volcanic mud.

[Bass Strait, 40 fathoms; common, Hincks.]

In the quite young state the surface appears to be reticulato-punctate, but generally it is closely nodulose. The nodules, more especially in the fertile or oœcial cells, are often developed into large verrucose elevations which sometimes project over the oœcial orifice so as almost to conceal it. The triangular operculum of the barren cells closely resembles that of *Lepralia arrogata*, Waters, from the Mediterranean, but in that form there is but one kind of operculum, which moreover does not present the transverse rugæ visible in that of *Schizoporella triangula*.

10. *Gephyrophora*, n. gen.

Character.—Zoarium dimorphous, either erect and irregularly branched, and cylindrical with the zoœcia disposed round an imaginary axis, or decurrent, loosely encrusting, and unilaminar. Zoœcia completely immersed, flat in front, parted by septal ridges. Surface beneath the epitheca finely reticulate. Primary orifice arcuate, with the lower border slightly sinuated, afterwards transversely oblong. A prominent avicularian process on each side of the orifice, the two eventually inarching and forming a bridge in front of it.

(1) *Gephyrophora polymorpha*, n. sp. (Pl. XXXIV. fig. 2).

The only species.

Habitat.—Station 142, lat. 35° 4′ S., long. 18° 37′ E., 150 fathoms, green sand.

[S. Africa, Mrs. Gatty.]

The zoarium appears to be dimorphous, or rather polymorphous, as it sometimes encrusts foreign bodies, in a single unattached layer. But even in its independent erect form, or more complete condition, as it may be termed, it is extremely variable in habit. Sometimes it presents long cylindrical distant branches, and sometimes assumes the form of stunted tufts or short branches, or even little more than irregular nodulated masses.

On a transverse section the interior of a branch exhibits no central axis nor interlaminar expansion. The interzoœcial walls are extremely delicate and closely perforated in all parts.

In the dried condition the cavity of each zoœcium is seen to be divided into two compartments, an anterior and a posterior, by a vertical diaphragm formed of an extremely delicate membrane. The hinder compartment, which in the dry state is very much the larger, lodges the polypide and communicates directly with the oral orifice, whilst the anterior, which probably exists as a chamber only in the dry state, being merely the space between the vertical diaphragm and the anterior calcareous wall, in the ordinary zoœcia does not appear to contain anything, but in others it is into this space that the subjacent oœcium intrudes, and may often be seen in the form of a spherical vesicle containing a vitelline mass or embryo. As a similar arrangement exists in *Siphonicytara* it is not improbable that this division of the zoœcial cavity into two compartments by a flexible membranous diaphragm will be found pretty generally in all zoœcia of which the wall is wholly rigid, and that it is intended for the purpose of allowing the compression of the perigastric cavity necessary to effect the protrusion of the polypide, which would otherwise seem to be scarcely possible in a perfectly unyielding box.

11. *Myriozoum*, Donati.

Myriozoum, Donati, 1750, d'Orb., Smitt (pars).
Millepora (pars), Pallas, 1766, Solander, Strom, Fabricius.
Myriapora, Blainv., 1834.
? *Foricula* (pars), d'Orb.
Cellepora (pars), *Leieschara*, Sars.
Gemellipora (sp.), Smitt.

Character.—Zoarium erect, branched, continuous; branches cylindrical, obtuse; or oviform. Surface punctured or reticulate. Avicularia, when present, immersed and usually placed near the orifice, either above, below, or on one or both sides. Orifice notched or sinuate, or canaliculate below.

The transition from the typical form of *Myriozoum* as exhibited in the well known *Myriozoum truncatum* to other cylindrical escharine growths, is so gradual that it is in

fact difficult to draw any definite line between them. In the sense in which the name is here employed, it is extended to embrace continuous zoaria, usually composed of cylindrical branches, for the most part of uniform diameter throughout, and in the more typical species obtusely rounded at the ends, towards which alone the orifices remain patent, the lower parts becoming more or less solidified and sometimes presenting no trace of the zoœcial structure either externally or internally.[1] In the less typical forms this condition does not attain to anything like the same extent, but in all there is a very great tendency to the obliteration of the zoœcia in the older parts.

Another circumstance in which the true or typical species of *Myriozoum* are distinguished from the rest, is the finely cancellated structure of the walls of the cells, or as it may be stated, of the entire substance in the actively growing parts. On the exterior this is indicated by the close reticulation, as it may be termed, rather than punctuation of the surface, whilst internally the walls of the zoœcia are generally very thick and finely cancellated, so that ample provision is made for the ready diffusion of fluid throughout the growth; which may not improbably be connected with the abundant deposit of calcareous matter in the older portions of the zoarium.

These differences in essential structure appear to be of sufficient importance to justify, if not the entire separation generically of the typical forms from others here included in the genus, at any rate the placing of them in a distinct section, as follows:—

§ 1. *Myriozoa typica.*

(1) *Myriozoum truncatum*, Donati.
(2) *Myriozoum subgracile*, d'Orbigny.
(3) *Myriozoum coarctatum* (Sars).

§ 2. *Myriozoa dubia.*

(1) *Myriozoum honolulense*, n. sp.
(2) *Myriozoum immersum*, n. sp.
(3) *Myriozoum simplex*, n. sp.
(4) *Myriozoum marionense*, n. sp.

All the forms in the Challenger Collection belong to the second division.

[1] When a portion of the completely solidified part of *Myriozoum truncatum* is decalcified, the chitinous opercula and shrunken remains of the endocyst may often be found enclosed in the interior.

(1) *Myriozoum honolulense*, n. sp. (Pl. XXV. fig. 2).

Character.—Zoarium about 0″·75 high, simply branched in all directions, rising from an encrusting base. Zoœcia rhomboidal, flat, with faint wavy septal ridges. Orifice orbicular, sinuated, perfectly even with the surface, lower lip slightly raised or tuberculated. Surface punctured. Small circular, scattered, immersed avicularia.

Habitat.—Off Honoruru, Sandwich Islands, 20 to 40 fathoms.

From the single small specimen this would seem to be a dimorphic form, that is to say, the base sometimes expands into a single hemescharine layer.

(2) *Myriozoum immersum*, n. sp. (Pl. XXV. fig. 4).

Character.—Zoarium with divergent, furcate ramifications, branches about 0″·125 in diameter. Zoœcia completely immersed, so that their outline is quite obscured; surface finely wrinkled longitudinally; orifice (primary) very deeply immersed at the bottom of a deep pit, on the sides of which are usually one or more very minute immersed avicularia with a pointed triangular mandible; the primary orifice itself is probably of an inverted horse-shoe shape. A very few scattered papillary eminences formed by the projection of the upper border of the oral pit in a cucullate form, each of which has a small avicularium on the under side (fig. 4*a*).

Habitat.—Station 320, lat. 37° 17′ S., long. 53° 52′ W., 600 fathoms, green sand.

In this case it is very difficult to make out the true form of the primary orifice, owing to the depth at which it is placed, even in the youngest zoœcia. In general, however, the secondary ? orifice has the form above mentioned, with one or more irregular internal projections. In the zoœcia which project in the form of conical papillæ the primary mouth would seem to be Myriozoan in character; the sinuation of the lower border is, however, very slight. The systematic position of the species is very doubtful.

(3) *Myriozoum simplex*, n. sp. (Pl. XXV. fig. 1).

Character.—Zoarium composed of slender cylindrical, dichotomous branches. Zoœcia at the growing extremities subventricose, distinct, in the older parts completely immersed and indistinct. Peristome in the younger cells raised, tubular, canaliculate or deeply emarginate in front; in the older cells forming merely a rounded eminence, with an apparently circular emarginate orifice. Surface rough, sparsely punctured; in the older portions smooth and shining. Oœcia ? deeply immersed. Avicularia 0.

Habitat.—Station 320, lat. 37° 17′ S., long. 53° 52′ W., 600 fathoms, green sand.

The proper generic position of this species is also extremely doubtful. The tubular peristome in the youngest zoœcia suggests an affinity with *Tessaradoma*, but there is no median pore, and the mouth is apparently that of a Myriozoan, although if the primary mouth could be seen it would probably be found to correspond in form with the very delicate operculum, which I have succeeded in isolating, and found to be semicircular with a straight entire lower border. The solid texture of the cell walls which are obscurely punctate, and the entire absence of any avicularian organs, are strongly against placing it with the typical *Myriozoa*. I do not however venture to make a new genus for its reception, and have therefore provisionally placed it under *Myriozoum*.

(4) *Myriozoum marionense*, n. sp. (Pl. XXIII. fig. 6).

Character.—Zoarium continuous, composed of long straggling cylindrical branches of uniform diameter, divaricating irregularly usually at right angles, occasionally anastomosing and constricted at irregular intervals. Surface in the natural state polished and covered with a plumbeous-coloured thick epitheca, beneath which it is punctate with elongated pores. Zoœcia completely immersed, with no visible outlines, disposed quincuncially on all sides of the branches. Orifice completely immersed, looking directly upwards, transversely elliptical anterior border thin, entire. A small avicularium with a spatulate mandible on each side just within the border of the orifice. No visible operculum. Oœcia 0.

Habitat.—Prince Edward Island, 80 to 150 fathoms. Station 151, off Heard Island, 75 fathoms, volcanic mud. Station 148, lat. 46° 47′ S., long. 51° 37′ E., 210 to 500 fathoms, hard ground, gravel and shells. Off Marion Island, 50 to 75 fathoms.

I place this very peculiar form under *Myriozoum* chiefly on account of its external habit which is exactly like that of that genus, especially as shown in *Myriozoum coarctatum*. But in other and more essential characters it differs so widely from the typical forms of the genus that its collocation with them must be regarded as entirely artificial.

The collection affords abundance of specimens in perfect preservation, but notwithstanding numerous attempts at decalcification I have been unable to detect a trace of an operculum, which I thence conclude must either be entirely membranous and very delicate, or perhaps wholly deficient.

12. *Haswellia*, n. gen.

Myriozoum, sp., Haswell.

Character.—Zoarium composed of short cylindrical branches, spreading in all directions dichotomously, at very open angles. Zoœcia disposed verticillately and more or less irregularly quincuncial, with a produced tubular or subtubular and bifid, or simply

thickened peristome, supporting on each side a small avicularium with a pointed subtriangular mandible. Primary mouth clithridiate with an operculum of corresponding form.

In a paper on some Polyzoa from the Queensland Coast, Mr. W. A. Haswell describes a species referred by him to the genus *Myriozoum*, with the specific name *australiense*. Before this paper came under my notice I had already described and prepared figures of the same species in the Challenger Collection and named it *Tessaradoma verticillatum*, which specific name of course must yield to Mr. Haswell's appellation, and as it appeared to me on further examination that the form could not be included under *Tessaradoma*, notwithstanding the presence of a suboral pore, I had like Mr. Haswell subsequently referred it to *Myriozoum*. But I have since come to the conclusion that notwithstanding certain points of resemblance it would be forcing the relation much too far to join it to the group of which the well known *Myriozoum truncatum* is the type. I have consequently thought that it might form the foundation of a distinct generic group, as another member of which I would add with much doubt a second species in the present collection, *Haswellia auriculata*, which, as in the case of *Haswellia australiensis*, I had originally referred to *Tessaradoma* and afterwards to *Myriozoum*.

(1) *Haswellia australiensis*, Haswell (sp.) (Pl. XXIV. fig. 9).

Myriozoum australiense, Haswell, Proc. Linn. Soc., N. S. Wales, vol. v. pt. 1, p. 33, pls. i.–iii. 1880.

Character.—Zoarium composed of short branches diverging dichotomously at wide angles and each containing four to five whorls of cells, each whorl composed of from six to eight or ten cells. Zoœcia completely immersed so that no outline is visible except the much produced tubular peristome, the anterior lip of which (when perfect) is trifid, each lateral tooth supporting a small avicularium with a subtriangular pointed mandible; the posterior lip finely crenulate. Primary mouth at bottom of tubular portion clithridiate, bidenticulate, and closed with a strong chitinous operculum of corresponding form and about 0″·007 × ·005 in size. In front of the tubular portion a rather large rounded pore formed at the bottom of a median fissure. Surface uniformly pitted or reticulato-punctate. Minute immersed avicularia with an acicular mandible pointing downwards, in the sulci between the zoœcia.

Habitat.—Station 186, lat. 10° 30′ S., long. 142° 18′ E., 8 fathoms, coral mud. Station 190, lat. 8° 56′ S., long. 136° 5′ E., 49 fathoms, green mud.

At first sight the tubular production of the peristome with the pore on its front presents a very strong resemblance to *Tessaradoma*, but the pore is of a totally different

nature. It has no communication with the body of the cell, as in that genus, nor has it the same tubular character, and its original mode of formation is apparently quite different. It belongs to what might be termed the simply suboral pores, whose function like that of the other special pores at present is altogether conjectural, but may be anal.

In the older or lower portions of the growth the peristomal tube becomes shorter and thicker and for the most part so mutilated as to present no trace of the trifid division of the anterior lip, the middle tooth of which however remains more or less distinct and is sometimes produced into a downwardly curved sort of beak.

(2) *Haswellia auriculata*, n. sp. (Pl. XXIV. fig. 10).

Character.—Zoarium about 0″·75 to 1″ high, composed of short forked branches. Zoœcia irregularly verticillate, about six in each whorl and usually in pairs; when young ovate slightly convex, when old completely immersed. A marginal row of distinct puncta round the border. Primary orifice horizontal, orbiculo-emarginate with a thin pointed process of the peristome on each side, supporting minute avicularia with an acute triangular mandible pointing upwards, the peristome afterwards becoming more or less tubular with a deep notch and sometimes a suboral pore in front. Oœcia numerous, with a circular area in front surrounded by a narrow raised fillet.

Habitat.—Station 135c, off Nightingale Island, 110 to 150 fathoms, and (135a) off Inaccessible Island, Tristan da Cunha, 75 to 90 fathoms, hard ground, shells, gravel. Station 142, lat. 35° 4′ S., long 18° 37′ E., 150 fathoms, green sand.

It is with some hesitation that I conjoin this species with the preceding, but as it seems to present more points of resemblance with *Haswellia australiensis* than with any other form with which I am acquainted, it seems convenient to do so provisionally at any rate rather than give it a separate generic appellation.

The younger zoœcia are quite distinct, with a subtubular orifice at first presenting a thin lamina on each side, which as they grow together more or less completely form an imperfectly tubular peristome, with a deep notch in front which sometimes eventually becomes a suboral pore, as in *Haswellia australiensis*, but which as in that species cannot be regarded as homologous with the median pore of *Tessaradoma*, &c. The row of marginal puncta is a feature also in common with *Tessaradoma*. But the difference in the present species, in this respect, between the older and younger portions of the zoarium is very great; also owing to the great thickening of the walls and the consequent deep immersion of the mouth, the lateral avicularia are deeply placed and may easily be overlooked. The oœcia in *Haswellia auriculata* are remarkable for their great number, almost all the cells in some specimens being crowned by one. In the younger unthickened parts these organs are subglobose and rather prominent, but they soon become more or

less immersed and in the oldest parts of the zoarium their site is indicated merely by a small circular pit close above the oral opening; this is owing to the circumstance that the central circular perforated area on their front is apparently never completely calcified.

13. *Tessaradoma*, Norman.

Pustulipora (pars), Sars.
Quadricellaria, Sars, Alder.
Onchopora (pars), Bk.
Anarthropora, Smitt.
Tessaradoma, Norman, Smitt.
Eschara (pars), Auctt.
Porina (pars), Hincks, *nec* d'Orb.

Character.—Zoarium continuous, erect, ramose, arising from a calcareous base, or by radical tubes. Stem and branches cylindrical. Zoœcia tubular above from production of the peristome A median circular pore usually with a raised shortly tubular border on the front. With or without immersed avicularia, and marginal pores.

I have preferred to retain Dr. Norman's appellation for this genus instead of *Porina* which has been adopted by Mr. Hincks (Brit. Mar. Polyz., p. 227), simply as it would seem for the reason that he considers it to be identical with the *Porina* of M. d'Orbigny. But as that author's Family Porinidæ has expressly for one of its characters "cellules entières, juxtaposées sur deux plans opposés sur un seul plan libre ou fixe" and gives as one of the characters of *Porina* "rameaux comprimés," and the cells "adossées les unes aux autres latéralement;" and as having neither "cellules accessoires ni vésicules ovariennes," and moreover cites two living species as belonging to it—*Porina africana* and *Porina* (*Eschara*) *gracilis*, Lamarck, neither of which, so far as I can perceive, has any character in common with *Tessaradoma*, I see no reason to follow him. Besides this, as the term *Porina* has been used by Prof. Smitt in another sense, it will I think obviate much confusion if Dr. Norman's name be retained.

Tessaradoma boreale, Busk (sp.) (Pl. XXIV. fig. 8).

Pustulipora gracilis, Sars, Reise i Löf. og Finnm. p. 26.
Quadricellaria gracilis, Sars, Norske Polyzoer, p. 15; Alder Quart. Journ. Micr. Sci., N. S., vol. iv. p. 101, pl. ii. figs. 9–12.
Onchopora borealis, Bk., *Ibid.*, vol. viii. p. 213, pl. xxviii. figs. 6–7.
Anarthropora borealis, Smitt, Kritisk Förteckn., pp. 8, 67, pl. xxiv. figs. 25–29.
Tessaradoma gracile, Norman, Brit. Ass. Rep., 1868, p. 309.
Tessaradoma boreale, Smitt, Florid. Bryoz., pt. 2, p. 32, pl. vi. figs. 143–145.
Porina borealis, Hincks, Brit. Mar. Polyz. vol. i. p. 229, pl. xxxi. figs. 4–6.

Character.—Zoarium one to two inches high or more, irregularly dichotomous. Branches cylindrical, subterete. Zoœcia usually quadriserial, alternate, subventricose;

parted by thin raised septal lines; surface longitudinally wrinkled; a row of distant pores near the border and a few others sparsely scattered on the front. Peristome tubular, curved forwards nearly at a right angle. Median pore usually subtubular, sometimes depressed, immediately below the peristome. Avicularia small, circular; slightly raised, sparsely disposed on the front and sides of the zoœcia. "Oœcia terminal, slightly raised, transversely elliptical, with a striated surface," Hincks.

Habitat.—Station 23, off Sombrero Island, North Atlantic, 450 fathoms, Pteropod ooze. Station 13, lat. 21° 38′ N., long. 44° 39′ W., 1900 fathoms, globigerina ooze.

[Norway, Finmark, between Norway and Spitzbergen—lat. 77° 5′ N., long. 10° 3′ E., 600 fathoms—Chydenius; Gulf of Florida, very abundant, Pourtalès; off the coast of Portugal and the Azores, Smitt; Shetland, Barlee].

In habit of growth this species varies a good deal, and according to Prof. Smitt it would appear to be more or less dimorphous, occurring in a lepralioid or alysidotal form, but of this no indication is afforded in the specimens that have come under my notice. And if one may be allowed to judge simply from Prof. Smitt's figures, I should be much inclined to doubt, with the greatest deference to him, whether his figures (*loc. cit.*) fig. 143, and the two lowermost zoœcia in fig. 144, really form part of the *Tessaradoma* at all, or have merely become accidentally associated with it. The latter figure at any rate might well be regarded as *Lepralia* (*Porina*) *ciliata*.

With respect to the median pore, one of the Challenger specimens presents an appearance which may perhaps afford some indication of the function of the opening in this situation. In this instance the slender tube (fig. 8*e*) rising from the pore is quite perfect, and slightly dilated at the end; through this short tube a cylindrical chitinous rod or tubule of a dark brown colour protrudes, upon the extremity of which is firmly affixed a small *Rotalina*. From this it would seem allowable to surmise that in some cases the so-called median or central pore may serve for the emission of a prehensile organ, capable of attaching itself to foreign bodies, and thus performing what may be supposed to be the function of an ordinary avicularium. But there can be no doubt, as I have observed above, that the nature and true homologies of these median pores are very various, and for the most part at present wholly unknown.

I have not as yet been able myself to perceive the primary mouth in *Tessaradoma boreale*, but from Prof. Smitt's figure (*loc. cit.*, pl. xxiv. fig. 29), it would appear to be circular, with a central opening through a hymen-like membrane—a very curious condition if it be correctly figured. The very delicate operculum, however, is circular with a thin chitinous thickening on each side and it is not perforated.

14. *Gemellipora*, Smitt.

Gemellipora (pars), Smitt, Florid. Bryoz., p. 37.

Character.—Zoarium erect and ramose, or crustaceous and adnate. Mouth elongate pyriform with an articular notch on each side below. Operculum of corresponding pyriform shape. A median immersed avicularium; either above or below the mouth.

(*a*) Erect and ramose (escharan).

(1) *Gemellipora glabra*, Smitt (Pl. XXV. fig. 3).

Gemellipora glabra (*forma typica*), Smitt, *loc. cit.*, p. 37, pl. xi. figs. 208–210.

Character.—Zoarium erect, cylindrical, irregularly branched. An orbicular immersed avicularium above most of the orifices; four or five curved rigid oral spines above.

Habitat.—Off Bahia, 10 to 20 fathoms, mud.

[Gulf of Florida, 36 to 42 fathoms, Pourtalès; John Adams' Bank, H.M.S. "Herald."]

In the older parts the zoœcia are completely immersed at the oral end, presenting only a slight tubercular projection surrounding a deep circular pit, within which the primary orifice is scarcely discernible. At the same time the supra-oral avicularium becomes either entirely obliterated, or is represented merely by a small pit.

I have retained Prof. Smitt's generic name, being reluctant unnecessarily to create a new one, although the appellation which was doubtless suggested by the habit of the zoarium in *Pasythea eburnea*, is no longer appropriate. Reluctant as I am to differ from Prof. Smitt, where it is possible to agree with him, I must confess that the generic and specific characters of *Pasythea* (*Gemellipora*) *eburnea*, and of *Gemellipora glabra* and *Gemellipora striatula* appear to me such as to render it impossible to associate them even remotely. Leaving out of consideration the other numerous points of difference, there is no resemblance even in the shape of the orifice upon which perhaps undue importance in many cases has been placed.

In the few fragmentary specimens afforded by the Challenger Collection I have failed to perceive any of the larger avicularia on the front of the cells noticed by Prof. Smitt. The peculiar curvature of the oral spines is well shown in his figure.

(*b*) Adnate (lepralian).

(2) *Gemellipora cribritheca*, n. sp. (Pl. XXXIII. fig. 5).

Character.—Zoœcia completely immersed, with very indistinct outline, surface closely punctate; flattened in front. Peristome very thin and quite level with the surface. A

small median suborbicular immersed, oral avicularium. Oœcia flattened in front with a depressed circular cribriform area.

Habitat.—Simon's Bay, Cape of Good Hope (on a *Membranipora*).

A second lepralian species of the genus, constituted as above, is the *Gemellipora striatula*, Smitt (*loc. cit.*, pl. xi. fig. 207), in which there is apparently a small median avicularium ? above instead of below the orifice.

Family XXI. Adeoneæ, n. fam.

Escharidæ (pars), Auctt.

Character.—Zoarium erect or (rarely) encrusting, affixed either by a more or less flexible jointed or unjointed, radicate, chitino-calcareous peduncle, or immediately attached to some flexible body, either with or without a contracted base. Bilaminar except when encrusting; foliaceous, expanded and fenestrate; or branched or lobate and entire. Cells of two or usually three kinds, zoœcial, oœcial, avicularian. No oœcia of the usual type. On the front a median pore, usually simple and circular, sometimes irregularly fimbriate, or represented by a depressed perforated areola. Usually one or more sessile avicularia on the front. In the oœcial cells the pore in most cases is suboral, or placed immediately below the mouth, and usually a minute avicularium on each side. The wall of the zoœcial cells is punctate or entire, that of the oœcial always punctate.

The forms included in the group above indicated appear to constitute a natural and well marked assemblage, distinguished, notwithstanding a considerable diversity of habit, by very peculiar characters. Amongst these may be briefly noticed:

1. The existence of three distinct forms of cells.

2. The entire absence of oœcia of the usual type, whose function appears to be discharged by special cells, usually marginal but sometimes interspersed amongst the others, from which they differ in size and form, as well as in other more important respects. They are, in the first place, usually larger, and are always more or less convex, instead of depressed in front, and their wall, whatever may be its condition in the barren or zoœcial cells, is always thickly punctate, as if to afford greater facility for the aeration of their contents. In the oœcial cells also the median pore is always placed close below the orifice,[1] and is always formed originally by the upgrowth and eventual coalescence of two tubercular elevations, one on either side, by which a sort of preoral bridge of two arches is sometimes formed, beneath which is the median pore, and on the sides or lateral piers of the bridge is usually placed a minute avicularium.

When decalcified the oœcial cell appears in the form of a thick walled sac, occupied by an ovoid finely granular mass resembling the contents of an ordinary oœcium. But

[1] *Adeona pectinata* is an exception in this respect.

in one or two instances I have noticed, instead of the ovoid, probably embryonic mass, the remains of a polypide with tentacles and digestive organs like those of the inhabitants of the zoœcial cells, whence we may suppose that the embryonic mass is developed from or in a polypide, which is gradually replaced by it.

3. The presence of a median pore or its equivalent, which though not formed or developed in the same way in all the Adeoneæ, doubtless subserves the same function in all, and in every case appears to me to differ widely in nature from the lunate pore in *Onchopora*, *Microporella*, &c., as well as from the tubular pores in *Tessaradoma*, *Tubucellaria*, &c.

In the Adeoneæ, the pore seems to be formed in at least three distinct ways. The most common perhaps is by the constriction off of the lower part of the orifice, which in such cases is more or less deeply emarginate or sinuated. But sometimes it appears to arise from an arrest of calcification of the front, independently of the orifice altogether, whilst in other cases it is represented by what may be termed a "perforated area," that is to say, a depressed area or space, the bottom of which, formed by a thin calcified lamina, is pierced by from one to six or eight small circular fimbriated porules, the whole bearing some resemblance, if not some homological relation, to an interzoœcial plate, or so termed "Rosettenplatte." Besides this pore the front of the zoœcial cells and sometimes of the oœcial also, is furnished with one or more sessile avicularia.

4. In several species, if not in all, besides the oœcial and zoœcial cells, others may be seen, usually on the extreme border of the lobes, branches or fenestræ, though sometimes interspersed, which may be termed avicularian cells, that is to say, which are wholly converted into "vicarious" avicularia, whose large mandibles often afford very useful specific characters.

5. To these more important characters may be added one which though minute is so constant as to deserve especial notice. It consists in the circumstance that in the entire group the avicularian mandibles both large and small always exhibit a projecting point or articular process at each end of the base, into or close to which the erector muscles are attached. To which may be added that so far as I have noticed the occlusor muscle of the mandible is always single instead of consisting of two bands as usual.

In doubtful fragments the above character of the mandibles will alone often be found useful as an indication of the affinities of the species.

Though the division is to a certain extent arbitrary, I propose to divide the Family into two or three groups, which may provisionally at any rate be regarded as of generic value.

These are :—

1. *Adeona*, Lamouroux.
2. *Adeonella*, n. gen.
3. *Reptadeonella*, n. gen.

the last including such forms as *Lepralia violacea*, which in all essential characters is an Adeonean ; and perhaps *Lepralia innominata*, and several fossil forms.

The number of species belonging to the Family in the Challenger Collection does not exceed seven or eight and includes only one typical *Adeona*. But the number of forms referrible to it leaving aside those whose identification is impossible from the imperfect descriptions published, and most of which have come under my own inspection, is very considerable, as will appear from the subjoined probably very incomplete list.

In his Monograph of the Genus *Adeona* Dr. Kirchenpauer[1] enumerates about eight forms which he regards as species, viz :—

(1) *Adeona foliacea* or *foliifera*, Lamx. and Lamk.
(2) *Adeona intermedia*, Kirchenpauer.
(3) *Adeona macrothyris*, Kirchenpauer.
(4) *Adeona arborescens*, Kirchenpauer.
(5) *Adeona grisea*, Lamouroux.
(6) *Adeona cellulosa*, Macgillivray.
(7) *Adeona albida*, Kirchenpauer.

To which have been since added :—

(8) *Adeona wilsoni*, Macgillivray.

Besides these published species I am acquainted from direct observation with five or six others that I have not been able to identify with any of the foregoing, and which will be included in a projected memoir on the genus which I hope to be able shortly to prepare.

(9) *Adeona appendiculata*, n. sp., Australia.
(10) *Adeona gattyæ*, n. sp., South Africa.
(11) *Adeona lancifera*, n. sp., Australia ?
(12) *Adeona valga*, n. sp., Australia.
(13) *Adeona microthyris*, n. sp., Australia.
(14) *Adeona lycopodioides*, n. sp., South Atlantic.

Of these a single specimen of the first only occurs in the Challenger Collection, and is here described. For the second I have long been indebted to the kindness of Miss Gatty, to whom I also owe several species of *Adeonella*.

Adeona valga and *Adeona lycopodioides* have been for many years in my collection, whilst *Adeona microthyris* appears to me to be a new species contained in a magnificent collection of Australian Adeoneæ, lately sent by Mr J. Bracebridge Wilson to the British Museum.

[1] Dr. Kirchenpauer, Ueber die Bryoz. Gattung Adeona, Hamburg, 1879.

The following is a list of the recent forms I should include in the subgenus *Adeonella* (*Eschara*, pars), Auctt.

* (1) *Adeonella atlantica*, n. sp.
* (2) *Adeonella platelea*, Busk.
* (3) *Adeonella intricaria*, n. sp.
* (4) *Adeonella polymorpha*, n. sp.
* (5) *Adeonella regularis*, n. sp.
(6) *Adeonella tuberculata*, n. sp. = *Eschara lichenoides*, Brit. Mus. Cat., *nec* Milne-Edwards.
* (7) *Adeonella distoma*, Busk (*coscinophora*, pars, Auctt).
(8) *Adeonella fuegensis*, Busk.
(9) *Adeonella sulcata*, Milne-Edwards.
(10) *Adeonella arcuata*, Busk, MS.
(11) *Adeonella falciformis*, Busk, MS.
(12) *Adeonella lichenoides*, Milne-Edwards.
(13) *Adeonella megapora*, n. sp., MS.
(14) *Adeonella dolichostoma*, n. sp., MS.
(15) *Adeonella natalensis*, n. sp., MS.
(16) *Adeonella crassa*, n. sp., MS.
(17) *Adeonella pallasii*, Heller.
(18) *Adeonella helleri*, n. sp. ? MS.
(19) *Adeonella dispar*, Macgillivray.
(20) *Adeonella mucronata*, Macgillivray.
* (21) *Adeonella pectinata*, n. sp.
(22) *Adeonella fissa*, Hincks.
(23) *Adeonella subsulcata*, Smitt.

Of this number, only those marked with an asterisk occur in the Challenger Collection.

3. The genus *Reptadeonella* includes the following species, which does not occur in the Challenger Collection :—

(1) *Reptadeonella violacea* (Johnston).

The Family here contains the following genera and species :—

1. *Adeona*, Lamouroux.

(1) *Adeona appendiculata*, n. sp. (Pl. XXXIII. fig. 6, and woodcut).

2. *Adeonella*, n. gen.

(1) *Adeonella polymorpha*, n. sp. (Pl. XXI. figs. 1*a*, 2*a*, and 3).
(2) *Adeonella platalea*, n. sp. (Pl. XXI. fig. 4).
(3) *Adeonella intricaria*, n. sp. (Pl. XXI. fig. 2).
(4) *Adeonella atlantica*, n. sp. (Pl. XX. fig. 7).
(5) *Adeonella regularis*, n. sp. (Pl. XX. fig. 2).
(6) *Adeonella distoma*, Busk.
(7) *Adeonella distoma*, var. *imperforata*?
(8) *Adeonella pectinata*, n. sp. (woodcut).

1. *Adeona*, Lamouroux.

Adeona, Lamx.; Lamk.; Kirch.; Auctt.
Dictyopora, Macgilliv., Nat. Hist. Vict., Dec. v. p. 37.

Character.—Zoarium erect, foliaceous, expanded, flabellate or lobate, fenestrate or entire, usually supported on a flexible or subflexible, chitino-calcareous, usually jointed stem, composed of radical tubes encrusted with calcareous matter, and attached by spreading radical fibres. If without a stem, generally attached to a flexible support.

1. *Adeona appendiculata*, n. sp. (Pl. XXXIII. fig. 6, woodcuts 47 and 48).

Character.—Zoarium light buff in colour; in the form of a simple flat circular or subcordiform expansion about 3″ in diameter, supported on a solid calcareous stem (probably continued into an articulated peduncle). Fenestræ circular, nearly as wide as the interspaces. Zoœcial cells oval, convex in front, with a large deep frontal fossa surrounded with a thick, rounded, smooth border; in the fossa a large circular pore at the lower part, and a very large avicularium with a spear-shaped mandible pointing upwards and rising to the side of the orifice. Orifice irregularly elliptical, usually rendered oblique by the presence of the avicularium. A single or double row of punctures round the border of the cell, and a few sparsely distributed on the front. Oœcial cells larger, orifice semicircular with a straight lower border. Avicularian cells of two kinds, one marginal around the fenestræ, with long curved pointed mandible, and another of minute size interspaced among the zoœcia with miniature mandibles, like those on the zoœcial cells. Opercula of the zoœcial cells inapparent; of the oœcial, very indistinct.

Habitat.—Station 163A, off Twofold Bay, 150 fathoms, green mud.

The only other species, and with which the present can, from its habit, be confounded, is the *Adeona grisea* of Mr. Macgillivray, which may or may not be the same as the *Adeona grisea* of Lamouroux and Kirchenpauer, though the latter at any rate may be doubtful. Mr. Macgillivray's figure (*loc. cit.*, Dec. vii. pl. lxvi. fig. 1), in the general habit bears

a strong resemblance to *Adeona appendiculata*, which is however more decidedly cordiform at the base and has a much longer rigid calcareous stem, but the characters of the zoœcia themselves differ very widely. The lateral papillary eminence below the mouth, which is seen in several other species, is wanting in *Adeona appendiculata*, and to judge from Mr. Macgillivray's figures the frontal avicularia in *Adeona grisea* are much smaller, and he makes no mention of the marginal avicularian cells, which form a marked feature in *Adeona appendiculata*.

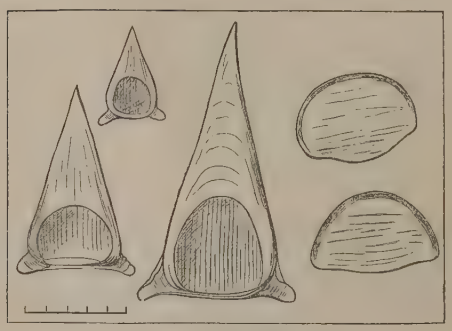


Fig. 47.—*Adeona appendiculata.*

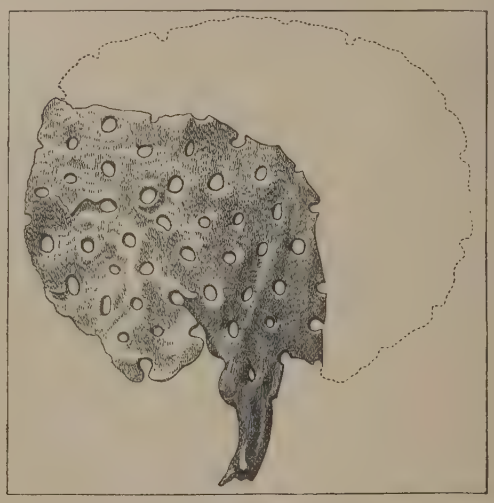


Fig. 48.—*Adeona appendiculata* (nat. size).

As regards colour, again, which is a very important character in the Adeoneæ, although Mr. Macgillivray does not notice it in his description, there is a very striking difference between the two. To judge from several fine specimens of what I take to be the *Adeona grisea* of Macgillivray lately sent by Mr. Wilson to the British Museum, the colour of that species is nearly black, whilst in the beautifully perfect and well-preserved specimen in the Challenger Collection the colour is that of a lightly baked biscuit. In *Adeona grisea*, also, the mandibles of the frontal avicularia are much smaller and nearly triangular, with an obliquely curved point, and those of the avicularian cells of the same character only much larger, and not at all like the marginal avicularia of *Adeona appendiculata*. *Adeona grisea* has distinct though delicate elliptical opercula both of the zoœcial and oœcial cells.

But another character which would alone suffice to distinguish *Adeona appendiculata* is the presence of the intercalated minute avicularia among the cells, and apparently not always if ever connected with any individual zoœcium. This character does not appear to exist in any other species with which I am acquainted. As the species is imperfectly figured in the Plates, woodcuts are given one of the organism, natural size, the other of the chitinous parts.

2. *Adeonella*, n. gen.

Eschara (pars), Auctt.

Character.—Zoarium erect, very variously branched or lobate, attached by a contracted base, or pedicle, often containing radical fibres and affixed usually on a more or less flexible support.

It is extremely difficult to point out any very definite line of distinction between some of the forms included under this subgenus and some of the non-fenestrate species placed under *Adeona*, as for instance *Adeona foliifera*, Lamarck, or *Adeona intermedia*, Kirchenpauer. The main difference consists in the absence in all cases of a jointed flexible stem, which again may or may not be present in one and the same species of the fenestrate kind as is the case in the species I propose to name *Adeona gattyæ*. But it is curious to observe that the want of flexibility in the peduncle itself is, in all instances that have come under my notice, supplied by the support itself being flexible, such as some hydroid growth, or fibre of *Gorgonia*, or *Antipathes*, a *Fucus*, sponge, &c.

As regards the general zoœcial characters, there is no difference whatever between *Adeona* and *Adeonella*, and in one respect the zoaria of the two resemble each other, for in many cases among the *Adeonellæ* there is a distinct midrib on the main stem and lobes, of precisely the same nature as the peculiar raised veins or ridges seen in most of the *Adeonæ*.

(1) *Adeonella polymorpha*, n. sp. (Pl. XXI. figs. 1*a*, 2*a*, 3, 3*a*, not figs. 1 and 2).

Character.—Zoarium 3 or 4 inches high, very thin, alternately pinnate like many ferns, with very strongly marked midribs. Zoœcial cells diversiform; when young, ovate or pyriform, convex or subcarinate in front with one or two longitudinal rows of puncta on the sides; when mature hexagonal and hollowed in front, the surface entire or very indistinctly punctured; a large circular simple pore, which in the young cell is formed immediately below the orifice by the constricting of the notch in the lower border, and thence gradually descends so as to become nearly central. Usually one or more small avicularia on the front, irregularly placed. The primary orifice suborbicular and emarginate, or clithridiate; in the mature cells, orbicular or elliptical with a thin peristome. Oœcial cells, larger, broadly ovate, and convex in front, the surface thickly punctured all

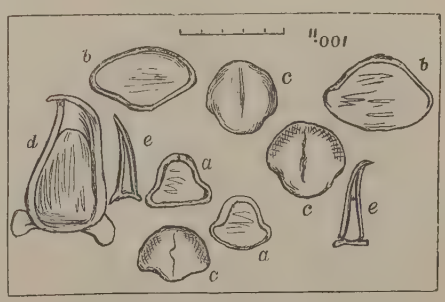


Fig. 49.—*Adeonella polymorpha.*

over, primary orifice arched above and sinuate below; afterwards crescentic and narrow owing to the rising in front of it of a thick transverse bridge beneath which is formed the suboral pore, often divided into two; and on each pier of the bridge a minute avicularium. Avicularian cells all marginal, with a short strong curved mandible pointing upwards.

Habitat.—Samboangan, 10 fathoms.

The chitinous appendages shown in the woodcut consist of *a,a*, probably immature zoœcial opercula which are rare; *b,b*, oœcial opercula; *c,c,c*, zoœcial opercula, which are thick and solid and often cracked down the middle; *d*, the mandible of a marginal avicularium; *e,e*, mandibles of frontal avicularia.

(2) *Adeonella platalea*, Busk (Pl. XXI. figs. 4, 4*a*, excluding the branched figure).

Eschara platalea, Bk., Brit. Mus. Cat., pt i. p. 90, pl. cv. figs. 1, 2, 3, and pl. cviii. fig. 4; Macgilliv., *loc. cit.*, Dec. vol. v. p. 41, pl. xlviii. fig. 4.

? *Eschara hexagonalis*, Haswell, Proc. Linn. Soc. New South Wales, 1881, vol. v. p. 41, pl. iii. figs. 1, 2.

Character.—Zoarium branched or irregularly lobate. Cells trimorphous. Zoœcia very uniform, hexagonal; convex or tumid in front with a smooth, uneven, entire surface, obscurely pitted round the border; in the older cells hollowed slightly in front. A large circular pore placed in the upper part of the front, on the sides one or more small avicularia (often absent). Orifice orbicular, with a thick rounded entire peristome. Oœcial cells larger, barrel-shaped, the wall closely punctate. Orifice (primary) broadly clithridiate or sinuate, afterwards semicircular or subcrescentic; a large suboral pore formed by the inarching of two tubercular processes, one on each side of the orifice and forming a bridge, beneath which is the pore, often divided into two; and on either side of the bridge a minute avicularium. Avicularian cells marginal or sometimes intercalated, the latter having a strap or spoon-shaped mandible.

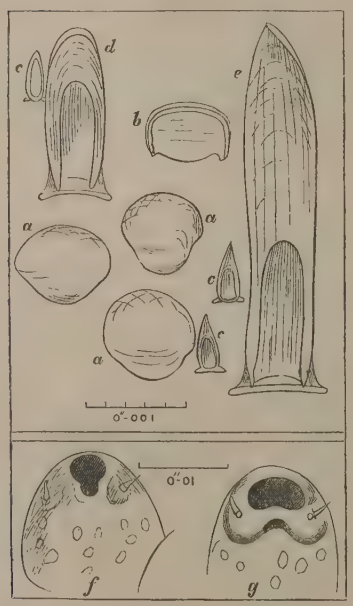


FIG. 50.—*Adeonella platalea*. *a, a, a*, Zoœcial opercula; *b*, an oœcial operculum; *c,c,c*, frontal avicularia; *d*, one of the intercalated avicularia; *e*, one of the marginal avicularia; *f*, primary mouth of a zoœcial cell; *g*, a secondary mouth.

Habitat.—Station 201, lat. 7° 3′ N., long. 121° 48′ E., 82 to 102 fathoms, stones and gravel.

[Bass Strait; off Cape Capricorn, Voy. of Rattles.; Queenscliff, Victoria, Macgillivray.]

The specimens of this species in the Challenger Collection are only a few small fragments, but in fair condition and sufficient to render

it highly probable that they belong to the same species as that procured on the Voyage of the "Rattlesnake." When calcined, the front of the zoœcia appears convex with a marginal row of punctures all round, and more sparsely punctured over the entire surface.

(3) *Adeonella intricaria*, n.sp. (Pl. XXI. fig. 2, and woodcuts 51–53).

Character.—Zoarium forms a tufted growth 2 or 3 inches in diameter, composed of narrow much compressed branches ramifying and frequently inosculating in all direc-

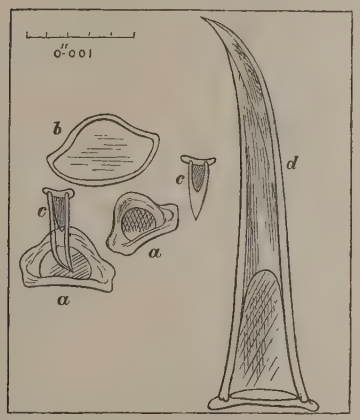


Fig. 51.—*Adeonella intricaria.* *a*, *a*, Zoœcial opercula; *b*, oœcial operculum; *c*,*c*, frontal avicularia; *d*, lateral avicularia.

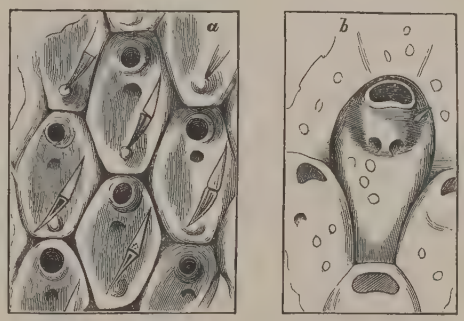


Fig. 52.—*Adeonella intricaria.* *a*, Mature zoœcial cells; *b*, an oœcial cell.

tions. Cells trimorphous. Zoœcial diversiform; when young, narrow, elongated, oval, convex in front, the convexity at the lower end rising into a conical eminence. Orifice much produced or subtubular, sometimes cucullate looking directly forwards, orbicular with a straight even lower lip. Peristome thin, entire; a large sublabial pore close below the orifice; surface obscurely punctured round the border; a small frontal avicularium, often absent. The mature zoœcia hexagonal, front much hollowed below the orifice with a well marked subconical eminence below, on the upper side of which is a large sessile avicularium whose acute projecting "beak" is prolonged obliquely downwards and inwards on the tuberosity. Mandible acutely lanceolate. Oœcial cells much larger, ovoid or pyriform, surface closely punctate. Primary mouth orbicular or semicircular, peristome projecting forwards and often cucullate. A large suboral pore often subdivided

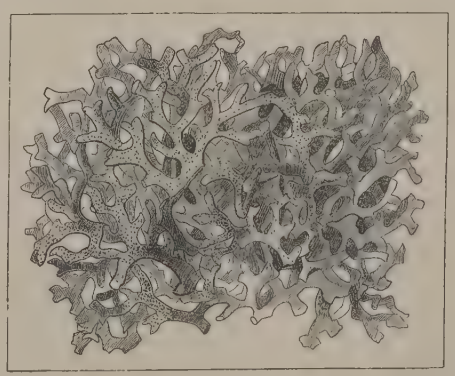


Fig. 53.—*Adeonella intricaria.* (Nat. size).

into two, and on either side, close to the angles of the mouth, a minute immersed avicularium. Avicularian cells mostly marginal, but sometimes interspersed amongst the others, with a long spear-shaped acute mandible.

Habitat.—Station 190, lat. 8° 56′ S., long. 136° 5′ E., 49 fathoms, green mud.

It is not improbable that this species may be identical with Mr. Haswell's *Eschara hexagonalis*, and not impossibly with M. Milne-Edwards' *Eschara lichenoides*, but the published materials are insufficient to determine the point. All difficulty however would at once be removed by the examination of the chitinous parts, and especially of the zoœcial opercula, which are of very peculiar and remarkable conformation in the present species, as will be seen in the figures.

(4) *Adeonella atlantica*, n. sp. (Pl. XX. fig. 7, woodcut 54).

Character.—Zoarium branched, branches expanded and bifid at the end. Cells trimorphous. Zoœcial, narrow, ovate, truncated at bottom; surface convex, rising into a rounded eminence below; sparsely punctured round the border and in three or four longitudinal rows in front. Orifice elliptical, raised, peristome sometimes cucullate. Median pore large, simple, circular, much depressed; a large avicularium on one side directed obliquely upwards and inwards towards the middle of the orifice over which it slightly projects; often a smaller avicularium on the opposite side near the orifice.

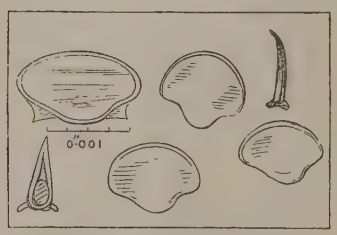


Fig. 54.—*Adeonella atlantica.*

Habitat.—Stations 135A and C, off Inaccessible and Nightingale Islands, Tristan da Cunha, 75 and 110 fathoms.

[Tierra del Fuego, 19 fathoms, Darwin; South Africa? Miss Gatty; ? Gulf of Florida, 10 to 18 fathoms, Pourtalés.]

I have inserted the last locality in some doubt whether the present species may not possibly be identical with Prof. Smitt's *Porina subsulcata* (Florid. Bryoz., part ii. p. 28, pl. vi. figs. 136–140). One of the most obvious characters of the species is the usually large avicularium pointing upwards and inwards so as to project slightly over the lower border of the mouth; another is the absence or comparative shallowness of the frontal depression and, when decorticated, the cribriform puncturation of the whole surface; and a third, the usually subcrescentic form of the mouth in the zoœcial cells; the frontal pore appears in this species to be unconnected with the mouth.

(5) *Adeonella regularis*, n. sp. (Pl. XX. fig. 2, woodcut 55).

Character.—Zoarium broadly lobate, thick. Cells disposed in very regular order, quincuncially, and separated by wide deep sulci, trimorphous. Zoœcial, rhomboidal or square with an angle at top and bottom; front very convex. In the natural state the

surface smooth and shining, when decorticated sparsely punctured all over. Orifice arched with a straight deeply emarginate lower lip. An avicularium with a curved, lanceolate, acuminate mandible pointing inwards on either side immediately above the mouth; in the mature cells a slender bridge in front of the deeply depressed mouth, formed by the gradual upgrowth of the wall on each side (not of the peristome proper). A very minute suboral pore is occasionally formed by the cutting away of a portion of the labial fissure.

Oœcial cells of the same form as the zoœcial but with a differently shaped operculum. Avicularian cells numerous, marginal, small.

Habitat.—Station 142, lat. 35° 4′ S., long. 18° 37′ E., 150 fathoms, green sand.

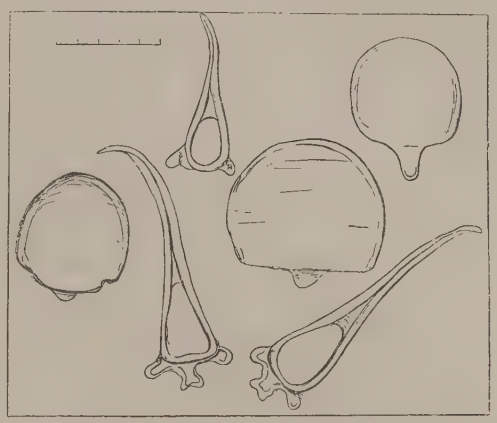


Fig. 55.—*Adeonella regularis*. *a*, Zoœcial operculum; *b*, *b*, oœcial opercula; *c*, *c*, *c*, mandibles.

I have not been able to distinguish the oœcial from the zoœcial cells in the natural condition, but infer that there must be such from the presence of the widely different form of opercula presented in a decalcified preparation. And with reference to this it should be noticed that, in some parts, cells may be observed in which there is no indication whatever of mouth or orifice of any kind, the front instead rising into a subconical eminence upon which a very minute avicularium is placed. Whether these are merely occluded zoœcial cells or represent oœcia may be doubtful. As regards the peculiar bridge formed in front of the mouth, it should be understood that it has nothing to do with the peristome, but is formed entirely from an upgrowth of the thickly calcified wall, the mouth remaining of its original conformation and with an unaltered peristome at the bottom of a deep pit.

What may be the perfect habit, size, or mode of attachment of the species cannot be ascertained from the fragmentary portions in the Challenger Collection.

(6) *Adeonella distoma* ? Busk (woodcuts 56, 57).

? *Eschara coscinophora*, Reuss, ? Foss. W. Tertiarb. p. 67, pl. viii. fig. 20.
„ „ *Id.*, Bryoz. des Sept., p. 70, pl. xi. figs. 1–4.
„ „ *Id.*, Fauna des deutsch. Oberoligocäns II. p. 36, pl. xii. fig. 12.
„ „ Stoliczka, Sitzungsb. d. k. Akad. Wiss. Wien, Bd. 1. p. 89, pl. ii. fig. 11, and pl. iii. figs. 1, 2.
„ „ Manzoni, Brioz. fossil. d. Miocene d'Austria ed Ungheria, p. 14, pl. viii. fig. 25.
? *Porellina coscinophora*, d'Orbigny, Palæont. Franç., p. 476.
Lepralia distoma, Busk, Quart. Journ. Micr. Sci., vol. vi. p. 127, pl. xviii. fig. 1.

Character.—Zoarium composed of long straggling ligulate branches (sometimes

decurrent or adnate). Zoœcia of one kind only (?) elongated, oval. Oral end prominent, subtubular, and bending forwards, especially in the lateral cells. Orifice arcuate with straight entire lower border. Immediately below the mouth is a median avicularium with an acute mandible pointing upwards and projecting usually beyond the lower border of the mouth. Below, the zoœcium is immersed, convex on the sides with an oval perforated areola in front, pierced by about seven fimbriate pores.

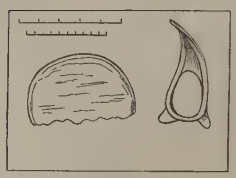


Fig. 56.

Habitat.—Station 75, lat. 38° 38′ N., long. 28° 28′ W., 450 fathoms, volcanic mud.

[Madeira, J.Y.J.; Atlantic 268 to 322 fathoms, Voy. of "Porcupine" (dead); Fossil, miocene, Reuss, &c.]

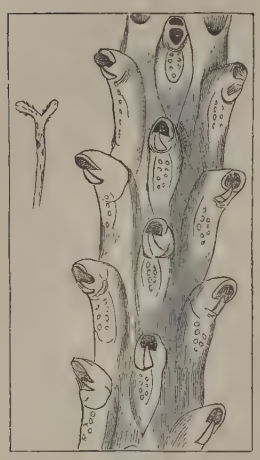


Fig. 57.

Figs. 56, 57.—*Adeonella distoma.*

The striking resemblance between the zoœcia in this form and those figured by Dr. A. E. Reuss in his later papers, is so close as to leave little room for doubt that the latter are very closely allied to if not identical with my *Lepralia distoma*. But if Dr. Reuss' earlier figure of *Eschara coscinophora*, in his Memoir on the Vienna tertiary fossils, is to be taken as the type, very considerable doubt might be thrown on the identification. But considering that the same original observer has regarded all those he figured subsequently as belonging to the same species, it would probably be right to yield the priority to him; otherwise the forms described in the later memoirs would clearly come under my designation.

The single small specimen in the Challenger Collection that I have noticed is in beautiful condition, and is shown in woodcut 57. Those I have from the "Porcupine" collection, on the other hand, are dead, and apparently much older and thicker, and they consequently demonstrate the similarity of the existing form with those of the Miocene period much more clearly than the younger living specimens.

(7) *Adeonella distoma*, var. *imperforata*, nov. (Pl. XX. fig. 4).

In the gathering from Station 122, lat. 9° 5′ to 10′ S., long. 34° 49′ to 53′ W., are one or two fragments of a small form, in which the characters of the zoœcia are precisely like those in *Adeonella distoma*, except that there is no perforated areola on the front.

(8) *Adeonella pectinata*, n. sp. (woodcut 58).

Character.—Zoarium about 1″ high, compressed obscurely carinate, expanding at the end, with short lateral branches or lobes. Cells trimorphous; zoœcial, narrow, ovate, and separated by shallow sulci. Front convex, and slightly hollowed in the middle with wide punctures. Mouth elliptical, transversely elongated, lower lip straight, entire, and within it a delicate pectinate denticle extending from side to side. A minute frontal avicularium on one side in a few of the zoœcia. Sublabial pore of large size. Oœcial cells rather larger, orifice arcuate, and in the mature cells with a straight lower border and a pectinate internal denticle. Most unarmed, but others have a small avicularium on a tubercular elevation on each side of the orifice. In these cells the pore is reniform, and placed low down on the front. Avicularian cells all marginal, of large size. Mandible of the retentive kind, obtuse, incurved at the point.

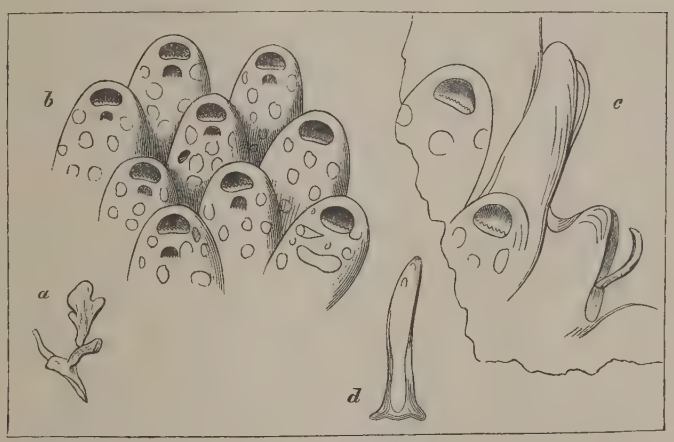


FIG. 58.—*Adeonella pectinata*. *a*, Natural size; *b*, zoœcia; *c*, marginal avicularium; *d*, mandible.

Habitat.—Station 186, lat. 10° 30′ S., long. 142° 18′ E., 8 fathoms, coral mud.

This is the only species of Adeonella in which I have noticed an internal denticle, by the presence of which it may consequently be at once distinguished; the retentive spatulate marginal avicularia are also distinctive; in all other cases so far as I know, those organs being of the prehensile nature. Unfortunately the collection affords only a single specimen, which it is desirable to keep entire, so that I have not attempted to isolate the chitinous parts, and can say nothing of the character of the operculum. The avicularian mandible however can be seen without any preparation; the position of the median pore, low down on the front of the oœcial cells, is also an exceptional feature.

Family XXII. Celleporidæ.

Celleporidæ, Johnst., Brit. Mus. Cat., Hincks, &c.
Escharidæ (pars), d'Orb.
Myriozoidæ (pars), Smitt.

Character.—Zoœcia urceolate, erect or suberect, irregularly heaped together and often forming several superimposed layers.

1. *Cellepora*.

Cellepora (pars), Fabric., Linn., &c., Brit. Mus. Cat., Johnst., Hincks, Auctt.
Tubipora (pars), Linn.
Millepora (pars), Ell. and Soland.
Celleporaria, Lamx., Reuss, d'Orb., &c.
Spongites, Oken.

Character.—Zoarium multiform; lamellar and encrusting, partially adnate, or free; or erect and attached by a thick base, massive or irregularly branched, solid or hollow; or in the shape of small parasitic pisiform or discoid growths. Zoœcia in the older portions more or less erect or vertical, very irregularly disposed or heaped together. Orifice entire or sinuated in front, with or without internal denticles. A pre-oral rostral process (sometimes aborted) usually supporting an avicularium; very generally interspersed avicularia.

The species here enumerated of this multiform and perplexing genus, may be conveniently arranged in two principal more or less artificial sections or groups, characterized primarily by the form of the operculum and secondarily by the general zoarial habit.

§ 1. Operculum suborbicular or semicircular, with a nearly straight lower border; avicularian mandibles usually with a short median columella.[1]

§§ *a. lobate, branched, or massive.*

(1) *Cellepora hastigera*, n. sp. (Pl. XXIX. fig. 1).
(2) *Cellepora tuberculata*, n. sp. (Pl. XXVIII. fig. 9).
(3) *Cellepora albirostris*, Smitt (Pl. XXXIV. fig. 7).
(4) *Cellepora aspera*, n. sp. (Pl. XXVIII. fig. 6).
(5) *Cellepora columnari*, n. sp. (Pl. XXIX. fig. 11).
(6) *Cellepora honolulensis*, n. sp. (Pl. XXIX. fig. 5).
(7) *Cellepora imbellis*, n. sp. (Pl. XXIX. fig. 7).
(8) *Cellepora jacksoniensis*, n. sp. (Pl. XXX. fig. 10).
(9) *Cellepora polymorpha*, n. sp. (Pl. XXX. fig. 11).

[1] This character, however, seems to be confined to species belonging to the Southern Hemisphere, as it is not present in the Mediterranean *Cellepora sardonica* and *Cellepora digitata*.

§§ *β. encrusting.*

(10) *Cellepora apiculata*, n. sp. (Pl. XXIX. fig. 2).
(11) *Cellepora samboangensis*, n. sp. (Pl. XXX. fig. 7).
(12) *Cellepora discoidea*, n. sp. (Pl. XXX. fig. 8).
(13) *Cellepora tridenticulata*, n. sp. (Pl. XXIX. fig. 3).
(14) *Cellepora vagans*, n. sp. (Pl. XXIX. fig. 10).
(15) *Cellepora mamillata*, var. *atlantica*, Busk (Pl. XXXV. figs. 4 and 5).

§ 2. Operculum pedunculate or produced downwards, with an articular notch on each side; no columella in the prehensile mandibles. Orifice usually emarginate in front.

§ *α. lobate, branched, or massive.*

(16) *Cellepora rudis*, n. sp. (Pl. XXVIII. fig. 7).
(17) *Cellepora solida*, n. sp. (Pl. XXIX. fig. 12).
(18) *Cellepora simonensis*, n. sp. ? (Pl. XXIX. fig. 9).
(19) *Cellepora pustulata*, n. sp. (Pl. XXVIII. fig. 8).
(20) *Cellepora cylindriformis*, n. sp. (Pl. XXX. fig. 9).
(21) *Cellepora eatonensis*, n. sp. (Pl. XXIX. figs. 4, 6, 8).
(22) *Cellepora ovalis*, n. sp. (Pl. XXVIII. fig. 5).

§§ *β. pisiform.*

(23) *Cellepora bicornis*, n. sp. (Pl. XXX. figs. 1 and 12).
(24) *Cellepora bilabiata*, n. sp. ? (Pl. XXX. fig. 2).
(25) *Cellepora signata*, n. sp. (Pl. XXX. fig. 3).
(26) *Cellepora conica*, n. sp. ? (Pl. XXVIII. fig. 10).
(27) *Cellepora ansata*, n. sp. (Pl. XXX. fig. 4).
(28) *Cellepora canaliculata*, n. sp. (Pl. XXX. fig. 5).
(29) *Cellepora bidenticulata*, n. sp. (Pl. XXX. fig. 6).
var. *subæqualis*, nov. (Pl. XXXVI. fig. 11).
(30) *Cellepora granum*, Hincks (Pl. XXXVI. fig. 10).
(31) *Cellepora tubulosa* (Hincks, sp. ?).

The number of species here referred to the genus *Cellepora* is about 30 or 31.

1. Of which the North Atlantic region yielded three, from depths varying from 51 to 450 fathoms.

2. The South Atlantic nine, from depths varying from 5 to 600 fathoms.

3. The Kerguelen or South Indian Region six, all from the neighbourhood of Kerguelen Island, and from depths varying from 20 to 500 fathoms.

4. The Australian Region twelve, all, with one exception (*Cellepora solida*), from depths varying from 2 to probably not more than 40 fathoms. The exception is a very aberrant form and only doubtfully referred to the same genus; it was procured from a depth of 2600 fathoms.

5. The North Pacific region furnished four species, at depths varying from 10 to 30 fathoms.

6. The South Pacific, only two, one from a depth of 45 fathoms, whilst the other appears to have been brought up from 1325 fathoms, near the western coast of South America. A curious circumstance, since the same species, *Cellepora eatonensis* (var. *magellanica*), occurred near the Falkland Islands at a depth of not more than 5 to 12 fathoms.

On the whole the genus as represented in the present collection would appear to belong to comparatively shallow water.

§ 1. Operculum suborbicular or semicircular with a nearly straight lower border; avicularian mandibles with a short median columella.[1]

§§ *a. lobate, branched, or massive.*

(1) *Cellepora hastigera*, n. sp. (Pl. XXIX. fig. 1, and Pl. XXXV. fig. 8).

Character.—Zoarium erect, expanded, lobate. Zoœcia deeply immersed, surface entire, dull. Orifice (primary) suborbicular, with a slightly sinuated lower border and no spines. Pre-oral rostra of two kinds, one very stout and subconical, supporting on the posterior face, either at or near the apex or lower down, an avicularium with either an acute or a duck-bill shaped mandible, and a toothed beak; the other slenderer and very acute, with a small lateral semicircular avicularium at the base overhanging a notch.

Habitat.—Station 162, off East Moncœur Island, Bass Strait, 38 fathoms, sand and shells.

In some respects the characters of this form render it doubtful whether it may not be a variety of *Cellepora bispinata*, Brit. Mus. Cat., or *Cellepora* (*Discopora*) *albirostris*, Smitt, Florid. Bryoz., but the total absence of any sign of the two long slender oral spines, present in those species, and the different form and proportions of the pre-oral rostral processes, render them, in my opinion, sufficiently distinct.

[1] *Vide* note, p. 190.

(2) *Cellepora tuberculata*, n. sp. (Pl. XXVIII. fig. 9, and Pl. XXXV. fig. 7).

Character.—Zoarium a rounded, massive irregularly nodular growth. Zoœcia perfectly upright, very deeply immersed below and more or less free above; often assembled in sets of three or four together. Orifice suborbicular or elliptical, about 0″·007 wide; a few excessively minute denticles within the lower border. Operculum subtriangular, rounded, about 0″·006 in diameter. Pre-oral rostrum small, conical obtuse, most frequently represented by a mere transverse tubercle; on the back of which is a very minute avicularium with a semicircular mandible. Oœcium partially recumbent, free, with a round pore on each side in front. Interspersed avicularia rare, columnar, vicarious; mandible blunt, triangular; beak obtuse, not toothed.

Habitat.—Station 163B, off Port Jackson, 35 fathoms, hard ground.

The open honey-comb appearance of the surface in this form and the peculiar habit (if constant) are at first sight very characteristic.

(3) *Cellepora albirostris*, Smitt (Pl. XXXIV. fig. 7, and Pl. XXXV. fig. 3).

Discopora albirostris (*forma typica*), Smitt, Florid. Bryoz. pt. ii. p. 70, pl. xii. figs. 234–239; (*nec.* Hincks).
? *Cellepora bispinata*, Busk, Brit. Mus. Cat., p. 87, pl. cxx. figs. 1, 2.

Character.—Zoarium massive, or irregularly lobate; erect, or partially encrusting sponges or *Fucus*. Zoœcia (marginal) barrel-shaped, surface pearly, smooth or finely granular; imperforate or with a few punctures round the border. Orifice (primary) suborbicular or arcuate; two long, very slender, unarticulated oral spines above; rostrum (where fully formed) very long, straight and acuminate, solid with a minute avicularium with semicircular mandible on one side of the base, and overhanging a wide sinus. On the older zoœcia, often a long solid upright acuminate spine, arising apparently from the side of the zoœcium about the middle of its length. The rostrum is often developed into a very thick subcylindrical process obliquely truncated at the end and presenting on the oblique face a large avicularium with a blunt spatulate mandible and toothed beak (fig. 7*d*). A few interspersed immersed retentive avicularia, usually placed transversely on the front of a zoœcium, and varying greatly in size; the mandible elongated obtuse or subspatulate, the beak simple or rounded.

Habitat.—Station 151, off Heard Island, 75 fathoms, volcanic mud.

As Prof. Smitt remarks, the typical *Cellepora albirostris* in a fresh condition is readily recognisable by its greyish-brown colour and blackish-brown operculum. The zoœcia, he goes on to observe, in the growing edge of the colony are elongated ovate, presenting the greatest resemblance to *Cellepora bispinata*, Brit. Mus. Cat. In this I quite agree with

Prof. Smitt, and am strongly inclined to think that his *Cellepora albirostris* is identical with my *Cellepora bispinata*. Unfortunately I have no specimen of the latter to compare, and the figure and description in the Brit. Mus. Cat. are hardly sufficient to determine the point. Under these circumstances I have thought it best to retain Prof. Smitt's appellation. I would remark, however, that the term "very minute," as applied to the usual kind of rostral avicularium, quite accords with that of *Cellepora albirostris;* the large rostral avicularia are only occasional.

With respect to Prof. Smitt's supposition that *Cellepora albirostris* and my *Cellepora mamillata* may be connected, I would observe, if I understand him correctly, that there can be no doubt of their complete distinctness. Nor can I see any reason for regarding the form described by Prof. Smitt under the name of *Cellepora* (*Discopora*) *pusilla* as merely a variety of his *Cellepora albirostris;* the two seem to me quite distinct, and how their close relation is "incontestably proved by the very same form of their zoœcial aperture," seems to me to be by no means clear, seeing that the form of aperture in question is one of very common occurrence.

(4) *Cellepora aspera*, n. sp. (Pl. XXVIII. fig. 6). Pl. XXX. fig. 9

Character.—Zoarium erect, cylindrical, irregularly branched, branches expanded at the end. Zoœcia immersed and ventricose below, produced or subtubular upwards, with a single row of punctures round the base, surface smooth, wall thick and porcellanous. Orifice suborbicular, with a wide sinus within which is an avicularium with a semicircular mandible; peristome thick, even. A few interspersed vicarious avicularia with short spatulate mandible. Oœcia? Operculum transversely elliptical, with a nearly straight lower border, 0″·0055 × ·004.

Habitat.—Station 122, 9° 5′ S., 34° 50′ W.; 350 fathoms, red mud.

The single specimen of this species is old and partially dead.

(5) *Cellepora columnaris*, n. sp. (Pl. XXIX. fig. 11, and Pl. XXXV. fig. 16).

Character.—Zoarium expanded, thick, irregular in form and extent. Zoœcia deeply immersed, ventricose, but with the outlines very obscure; substance of wall solid, porcellanous; surface finely granular; orifice semicircular, lower lip straight and entire. A long, solid, tapering, columnar process springs from the back of the zoœcium close to the mouth, and rather to one side. In many zoœcia there is a small tubercular avicularian process in front below the orifice, which also sometimes rises in a columnar form; mandible triangular.

Habitat.—Station 162, off East Moncœur Island, Bass Strait, 38 fathoms, sand and shells.

(6) *Cellepora honolulensis*, n. sp. (Pl. XXIX. fig. 5, and Pl. XXXV. fig. 15).

Character.—Zoarium massive, irregular. Zoœcia very confusedly crowded, deeply immersed, surface finely granular, imperforate. Orifice (primary) semiorbicular, or subtriangular, lower border straight, with a minute three-toothed pectinate process within it. A short pointed pre-oral rostrum, supporting on one side a small avicularium, with a semicircular mandible. In the older parts, very numerous large interspersed prominent avicularia, with a lanceolate mandible pointing upwards, and simply channelled beak.

Habitat.—Off Honoruru, Sandwich Islands, 20 to 40 fathoms.

Differs from *Cellepora tridenticulata* in the much smaller size of the internal denticles, which rather resemble a minute three-toothed comb, and in the almost universal presence on the front of the older zoœcia of a prominent avicularium with a lanceolate mandible and simply channelled not serrated beak.

(7) *Cellepora imbellis*, n. sp. ? (Pl. XXIX. fig. 7, and Pl. XXXV. fig. 20).

Character.—Zoarium lamellar, flexuose, thin. Zoœcia distinct, erect, free above, ventricose and immersed below; surface finely pitted. Orifice arcuate or subtriangular or suborbicular, about 0″·006 wide, peristome slightly thickened; a small avicularium in front just within the border. A few interspersed, immersed avicularia, with duck-bill mandible.

Habitat.—Off Bahia, 10 to 20 fathoms.

Only a single specimen apparently old and dead.

(8) *Cellepora jacksoniensis*, n. sp. (Pl. XXX. fig. 10, and Pl. XXXV. fig. 9).

Character.—Zoarium branched; branches compressed. Zoœcia barrel-shaped, very distinct at the growing edge (fig. 10*a*), elsewhere confused; surface granular; a row of small perforations round the border. Pre-oral process short, pointed, trifid, having an avicularium, with a rounded mandible, on one side towards its base, which forms one border of the labial fissure. Orifice orbicular, widely notched below. Some of the lateral zoœcia have in front a strong projecting avicularian process, with a lanceolate mandible, and the beak cupped and toothed (fig. 10*b*).

Habitat.—Station 163B, off Port Jackson, 35 fathoms, hard ground.

(9) *Cellepora polymorpha*, n. sp. (Pl. XXX. fig. 11).

Zoarium irregularly branched, branches tapering, short. Zoœcia very confusedly disposed; surface coarsely granular. Orifice (primary), (fig. 11*a*), circular, widely emargin-

ate ; afterwards the peristome becomes much thickened and raised (fig. 11*b*), so as to conceal the primary mouth. Three or four acute curved denticles within the peristome, which in this stage is unarmed. In other zoœcia the labial sinus becomes fissural, and eventually converted more or less completely into a suboral pore, whilst in front the peristome forms a prominent tubercular eminence (fig. 11*c*), supporting on the side overlooking the fissure a large avicularium, with a rounded triangular mandible and toothed beak. A few interspersed avicularia (fig. 11*d*,*e*), on low horizontal eminences, with a spatulate retentive mandible often squarely truncated, and bifid beak. Oœcia (fig. 11*f*), erect or subrecumbent, globose; surface finely granular. Opercula semicircular about 0″·008 × ·0035.

Habitat.—Off Honoruru, Sandwich Islands, 20 to 40 fathoms.

§§ *β. encrusting.*

(10) *Cellepora apiculata*, n. sp. (Pl. XXIX. fig. 2, and Pl. XXXV. fig. 12).[1]

Character.—Zoarium encrusting, or unilaminar and unattached. Zoœcia (at the growing edge), ventricose or barrel-shaped, with a granular unpunctured surface. In the older portions deeply immersed and very confusedly disposed, varying much also in size. Primary orifice semicircular, with a straight entire lower border, and surmounted in the earliest stage by two, or more rarely three, long oral spines. Pre-oral rostrum very irregular in size and supporting usually on one side a large avicularium with an obtuse serrated beak, and a subacute lanceolate or triangular mandible, and usually produced beyond the avicularium into a longer or shorter, obtusely apiculate spine.

Habitat.—Station 163B, off Port Jackson, 35 fathoms, hard ground.

The extreme irregularity of growth and great diversity in the form and size of the pre-oral rostrum, which is sometimes very small, and at others developed into a very large avicularian process, render any definite description of this species very difficult. The chief points it presents are : 1. The semicircular orifice (about 0″·07 wide), with a straight entire lower lip ; 2. The, at first, short and thick hollow rostrum, which afterwards becomes produced into an obtuse spine, and on the side of the wider portion, some distance above the base, supports on one side a large avicularium with a finely serrated beak and rather blunt but elongated mandible ; 3. The presence on the youngest zoœcia only of two or sometimes three long oral spines, like those in *Cellepora bispinata*, Busk, or *Cellepora albirostris*, Smitt.

(11) *Cellepora samboangensis*, n. sp. (Pl. XXX. fig. 7, and Pl. XXXV. fig. 10).

Character.—Zoarium expanded, thick, loosely adnate, surface uneven but not distinctly mamillated. Zoœcia distinct, very confusedly disposed, obscurely punctured

[1] The figure has unfortunately been taken from a very bad specimen, and shows little of the real characters. The chitinous parts, however, suffice to distinguish it.

round the border; the interspaces are sometimes irregularly cancellated. Surface porcellanous. Primary orifice suborbicular, sinuated below; operculum semiorbicular with a straight lower border about 0″·006 × ·004. Pre-oral rostrum small, conical, obtuse, presenting on one side near the base a very minute avicularium, with a semi-elliptical mandible pointing upwards. Interspersed prominent avicularia, with a short duck-bill shaped mandible and simple non-serrated beak. Very rarely one of large size, completely immersed, with a long spatulate obtuse mandible very wide at the base.

Habitat.—Off Samboangan, 10 fathoms.

In the figure the orifice is represented as notched on one side, but the apparent notch is merely caused by the projection of the base of the rostrum; the rostral avicularium is represented larger than it should be. The form may probably be only a variety of *Cellepora polymorpha*.

(12) *Cellepora discoidea*, n. sp. (Pl. XXX. fig. 8, and Pl. XXXV. fig. 1).

Character.—Zoarium (in a single specimen) discoid, unilaminar, attached only at the centre. Zoœcia (at the growing edge) ventricose; surface granular, entire. Primary orifice (fig. 8*b*) suborbicular or elliptical with a minute three-toothed process within the lower border, which is gradually developed into a large pre-oral rostrum (fig. 8*a*) on one side at the base of which is a small labial sinus and posteriorly a large avicularium with a duck-bill shaped mandible and a toothed beak (*c*); beyond which the rostrum in the older zoœcia is produced in the form of a strong conical solid spine. A few interspersed recumbent, subimmersed avicularia with a long lanceolate retentive mandible and simple non-serrated beak (*d*).

Habitat.—Station 186, off Cape York, 8 fathoms, coral mud.

The peculiar characters of this species are derived from: 1. The entire suborbicular orifice, within the lower border of which is, in quite the earliest stage, after the calcification of the front of the zoœcium is completed, a minute tridenticulate process, which appears progressively to become a rounded eminence (fig. 8*b*), toothed or serrated at the summit, the serrations forming the upper border of an avicularium; and as growth goes on, this eminence rises into a thick obtuse pre-oral rostrum, which always retains the serrated edge of a large avicularium (fig. 8*c*); at a still further stage this obtuse rostrum is produced beyond the avicularium into a strong conical pointed solid spine. 2. Another character is shown in the interspersed retentive avicularia, which are of a wholly different character from that on the rostrum, being elongated, deeply immersed, in the form of a shallow boat and have a long lanceolate mandible and simple non-serrated beak. It may also be remarked that in this species there are two *lemnisci* attached to the tentacular sheath.

(13) *Cellepora tridenticulata*, n. sp. (Pl. XXIX. fig. 3, and Pl. XXXV. fig. 17).

Character.—Zoœcium lamellar, expanded, apparently unattached, uneven. Zoœcia deeply immersed, surface shining, granular, imperforate. Orifice arcuate or subtriangular, with three, sometimes four, internal denticles within the lower border, and about 0″·006–·007 wide. Rostrum (sometimes absent) a small rounded tubercle seated in a shallow depression, supporting on the summit, a minute avicularium with a semicircular mandible. A strong articulated spine on each side of the orifice. Large interspersed prehensile avicularia (fig. 3*b*), apparently vicarious (certainly not rostral); usually immersed but sometimes more prominent and partially erect, with a short duck-bill shaped mandible, shutting down into a shallow boat-like beak, the edge of which is finely pectinate.

Habitat.—Station 186, off Cape York, lat. 10° 30′ S., long. 142° 18′ E., 8 fathoms, coral mud.

This well marked species is at once recognisable by the long articulated and indistinctly jointed oral spine on each side of the orifice. The limited development of the rostrum with its little imbedded avicularium is also a well marked feature, as is also the fine pectination of the border of the cup or beak in the interspersed avicularia. Another curious feature is the frequent occurrence on the surface of the zoarium of long tubular processes or tunnels, looking like enormously elongated zoœcia. The nature of these appendages appears very obscure.

(14) *Cellepora vagans*, n. sp. (Pl. XXIX. fig. 10, and Pl. XXXV. fig. 11).

Character.—Zoarium encrusting, of a dark olive colour. Zoœcia small, with a single row of puncta round the border; surface granular. Primary orifice (fig. 10*a*) orbicular or subclithridiate, the peristome much produced in front, with a wide sinus; afterwards rising into a hollow, conical pointed rostrum, which usually supports on one side a minute avicularium, with a semicircular mandible. Numerous large interspersed avicularia, whose mandible (fig. 10*c*) sometimes expands at the extremity into three or four branches, connected by a delicate membrane, capable of being spread over foreign bodies, and is sometimes pointed, but always more or less membranous towards the end.

Habitat.—Station 148, lat. 46° 47′ S., long. 51° 37′ E., 210 fathoms. Off Honoruru, Sandwich Islands, 20 to 40 fathoms.

The peculiarities of this species are: 1. The almost tubular production of the peristome even in the youngest zoœcia; 2. the peculiar conical pointed form of the preoral rostrum, which sometimes represents merely an obtuse tubercle, but is more commonly of an acute conical shape, the apical portion of which, being denuded of the dark fuscous

epidermis, appears of an ivory whiteness, and with a finely granular surface and porcellanous aspect. The mode in which the partially membranous mandible of the larger avicularia sometimes spreads like a duck's foot over foreign bodies is very curious. In colour and superficial aspect, this form might be confounded with *Cellepora mamillata*, but they are in reality quite distinct.

(15) *Cellepora mamillata*, var. *atlantica*, Busk (Pl. XXXV. figs. 4, 5, and 13).

Cellepora mamillata, Bk., Brit. Mus. Cat., p. 87, pl. cxx. figs. 3, 4, 5.

Character.—Zoarium encrusting, mamillated. Zoœcia erect, very irregularly disposed, deeply immersed. Surface finely granular, not punctured. Primary orifice suborbicular, with a straight lower margin. An acute pre-oral rostrum, with an avicularium near its base overlooking a small notch. Interspersed avicularia of two kinds, prehensile, with a duck-bill shaped mandible, and retentive with a long spatulate, membranous mandible.

Habitat.—Off Bahia; 10 to 20 fathoms (Pl. XXXV. fig. 4). Station 148, lat. 46° 47′ S., long. 51° 37′ E., 210 fathoms, hard ground, gravel and shells (Pl. XXXV. figs. 5 and 13).

[Coast of Patagonia, Darwin; Australia.]

Notwithstanding a slight (but constant) difference in the operculum, with respect mainly to the points of attachment of the occlusor muscles, and the apparent absence of the retentive kind of avicularia in the Australian specimens of *Cellepora mamillata*, the correspondence, in all other respects, with the South Atlantic form is so close as to leave little doubt as to the specific identity of the two forms.

§ 2. Operculum pedunculate or produced downwards, usually with an articular notch on each side. No median columella in the mandibles.

§§ *a. lobate, branched, or massive.*

(16) *Cellepora rudis*, n. sp. (Pl. XXVIII. fig. 7, and Pl. XXXVI. fig. 7).

Character.—Zoarium (in a single specimen) consisting of a short thick cylindrical stem rising from a broad base, and dividing into two rounded lobes. Aspect rugose and coarse. Zoœcia completely immersed and very confusedly heaped together. Orifice subquadrangular, large (nearly 0″·01 wide), depressed. Pre-oral rostrum, in the ordinary zoœcia, merely a tubercle supporting an avicularium, with a blunt elliptical mandible, pointing downwards; in the fertile zoœcia the rostrum is developed into a broad hollow process, from which the raised border passes back on each side of the orifice to the sides of the oœcium. Oœcium deeply immersed, having on the front a crescentic disc, marked

with radiating furrows. Very numerous, interspersed, immersed avicularia, lying in all positions and of very various sizes, with a broad short mandible, much contracted at the base.

Habitat.—Station 320, lat. 37° 17′ S., long. 53° 52′ W., 600 fathoms, green sand.

(17) *Cellepora solida*, n. sp. (Pl. XXIX. fig. 12).

Character.—Zoarium ramose or globate, very irregular; in the older portions the zoœcia are, as it were, all fused together and coated with a porcellanous deposit, so that all trace of openings is lost. Zoœcia (younger) barrel-shaped, wide above. Orifice quadrangular, border entire; the zoœcium rises behind the mouth into an obtuse, conical process, usually presenting a small avicularium, with a triangular mandible, on the anterior aspect. In front of the mouth is a much larger, rounded, tumid prominence, on which are, occasionally, placed a few very minute, circular avicularia, also with an obtuse triangular mandible. Occasional large, interspersed avicularia (fig. 12*a*), with a broad short spatulate mandible. Operculum suborbicular about 0″·01 × ·0095.

Habitat.—Station 160, lat. 42° 42′ S., long. 134° 10′ E., 2600 fathoms, red clay.

The entire growth is solid and has a porcellanous aspect, and in habit bears a strong resemblance to *Celleporaria polythele*, Manzoni, Brioz. fossil. d. Miocene d'Austr. ed Ungh., p. 4. pl. i. fig. 3.

(18) *Cellepora simonensis*, n. sp. ? (Pl. XXIX. fig. 9, and Pl. XXXVI. fig. 8).

Character.—Zoarium branched or massive and irregular; surface uneven, nodulated or papillose. Zoœcia deeply immersed and ventricose, with a row of punctures round the border, and sometimes sparsely punctured all over. Orifice clithridiate, peristome thick; in the older stage annular or shortly tubular. An obtuse avicularian process on one side close below the orifice, with a broadly triangular mandible, pointing upwards. Sometimes interspersed minute immersed avicularia with a spatulate mandible.

Habitat.—Simon's Bay, Cape of Good Hope.

The operculum is of the same shape as the orifice, and has a pyriform thickening on each side (Pl. XXIX. fig. 9*a*). The interspersed avicularia in the older parts of the zoarium appear to be vicarious, *i.e.*, transformed zoœcia of small size.

(19) *Cellepora pustulata*, n. sp. (Pl. XXVIII. fig. 8).

Character.—Zoarium cylindrical, irregularly branched; branches slightly tapering. Zoœcia in the younger portions, distinct, ventricose; walls entire, uneven. Orifice clith-

ridiate, peristome thin. In the older zoœcia a small tubercular pre-oral process, having on one side a minute avicularium, with a subtriangular mandible. In the older portions the individual zoœcia are for the most part obliterated, and in these parts of the zoarium the surface presents small pustular, subhexagonal eminences, each of which has a minute avicularium in the centre. Besides these there are a few interspersed retentive avicularia with a spatulate mandible, with a very contracted base.

Habitat.—Station 167, lat. 39° 32′ S., long. 171° 48′ E., 150 fathoms, blue mud. Off Marion Island, 50 to 75 fathoms.

(20) *Cellepora cylindriformis*, n. sp. (Pl. XXX. fig. 9, and Pl. XXXVI. fig. 9).

Character.—Zoarium conical or tapering. Zoœcia large, distinct. Orifice (fig. 9*a*) orbicular, widely emarginate. A strong, incurved, cylindrical pre-oral process, supporting a large avicularium (fig. 9*a*), with a broad, equilateral triangular mandible. Interspersed avicularia (fig. 9*b*) not numerous, having a broad, short, membranous mandible, either of a duck-bill form or squarely truncate. Oœcia (fig. 9*a*) small, erect, globose, punctured.

Habitat.—Station 142, lat. 35° 4′ S., long. 18° 37′ E., 150 fathoms, sand.

The only specimen is of a cylindrical form about 0·75 inch long, by 0·1 in diameter, appearing, but not certainly, to be moulded on a worm tube.

(21) *Cellepora eatonensis*, n. sp. (Pl. XXIX. figs. 4, 6, 8, and Pl. XXXVI. figs. 3, 4, 5).

Character.—Zoarium multiform, massive, or branched; the branches short, thick, and obtuse, or more or less lamellar, and free; or incrusting, or parasitic, and more or less globose. Zoœcia (young) barrel-shaped, (fig. 4), afterwards ventricose; surface entire, smooth. Orifice subarcuate, with a wide notch. Pre-oral rostrum very variable in size and conformation; small and conical, or very large and cylindrical towards the end, and deeply channelled on the posterior aspect, but always hollow (fig. 8 *b*), supporting near the extremity a small avicularium, with a semicircular mandible. Numerous very large interspersed avicularia, with a duck-bill shaped mandible, shutting down into a deep cupped beak, the end of which is gouge shaped, and the border entire and sharp.

Habitat.—Station 149D, RoyalSound, Kerguelen, 28 fathoms. Stations 149 H, J, K, off Christmas Harbour, Kerguelen, 45 to 127 fathoms. Station 303, lat. 45° 31′ S., long. 78° 9′ W., 1325 fathoms, Globigerina ooze. Station 315, lat. 51° 40′ S., long. 57° 50′ W., 5 to 12 fathoms, sand.

Though exhibiting considerable diversity, especially in the greater or less development of the rostrum, the specimens from the above localities agree in all essential particulars,

such as the shape of the orifice and operculum, the presence of the small rostral semicircular avicularium, which is sometimes terminal, sometimes seated below the summit, which may be prolonged into an acuminate point beyond it,—but more particularly by the peculiar conformation of the numerous and large interspersed avicularia. At first I was disposed to divide the form into three species, *Cellepora eatonensis*, *Cellepora magellensis*, and *Cellepora rostrata*, but I am now quite satisfied that they are all specifically identical.

(22) *Cellepora ovalis*, n. sp. (Pl. XXVIII. fig. 5, and Pl. XXXV. fig. 6).

Character.—Zoarium ramose, branches cylindrical, tapering. Zoœcia distinct, very prominent in the younger parts. Orifice orbicular, with a notch on one side. Pre-oral process strong, hollow, pointed, varying very much in height, and being much more prominent and pointed on the younger branches, than on the the main stem; it supports an avicularium with a wide triangular mandible, the beak simple. Oœcia subrecumbent, with two or three raised pores in front. Interspersed avicularia few, of an oval form.

Habitat.—Station 75, lat. 38° 37′ N., long. 28° 30′ W., 450 fathoms, sand (parasitic on a bundle of radical fibres of a Sertularian).

The labial notch in this case resembles that which occurs in most of the Retepores; it is not median but placed to one side, and appears to have a tendency to become converted into a sub-oral pore.

§§ *β. pisiform.*

(23) *Cellepora bicornis*, n. sp. (Pl. XXX. figs. 1 and 12, and Pl. XXXVI. figs. 13, 15).

Character.—Zoarium, globose. Zoœcia ventricose below, becoming tubular above. Orifice circular, notched (fig. 12 *a*); peristome much raised, tubular (fig. 12 *b*) and furnished in the perfect, sterile zoœcia with two cylindrical pre-oral processes, having on their summits minute avicularia, with acute, triangular mandible; besides these processes the peristome supports two to four spines, which in the perfect zoœcia are replaced by a decumbent globular oœcium (fig. 12 *c*), having a rounded fissure in front; the surface otherwise of the oœcium is smooth and polished. A very few interspersed avicularia (fig. 12 *d*) with an excessively delicate membranous mandible of a broadly lanceolate form.

Habitat.—Prince Edward Island, 80 to 150 fathoms. Marion Island, 50 to 75 fathoms. Station 150, lat. 52° 4′ S., long. 71° 22′ E., 150 fathoms, rock. Station 314, lat. 51° 36′ S., long. 65° 40′ W., 70 fathoms, sand and gravel. Station 313, lat. 52° 20′ S., long. 65° 40′ W., 55 fathoms (parasitic on *Myriozoum truncatum* and on *Onchopora sinclairii*).

(24) *Cellepora bilabiata*, n. sp. ? (Pl. XXX. fig. 2).

Character.—Zoarium pisiform, very minute. Zoœcia very irregularly disposed erect, pitcher-shaped. Mouth circular, emarginate (fig. 2*a*); peristome thick and often produced into a rather deep, bilabiate cup (fig. 2*b*). In some zoœcia, a short strong, conical pre-oral process. Oœcia (fig. 2*c*) small, spherical, recumbent.

Habitat.—Station 161, off Port Philip, 33 fathoms, sand (parasitic on *Amathea spiralis*).

The collection affords only one or two small specimens scarcely sufficient for the purpose of diagnosis.

(25) *Cellepora signata*, n. sp. (Pl. XXX. fig. 3, and Pl. XXXVI. fig. 14).

Character.—Zoarium pisiform. Zoœcia deeply immersed and very confusedly arranged; surface smooth, shining. Orifice (fig. 3*b*) arcuate, with a straight lower lip, having a very minute median notch. A strong, curved, hollow pre-oral rostrum, with an avicularium on its posterior aspect near the summit, with a short, obtuse, spatulate mandible pointing upwards. A few large, interspersed avicularia (fig. 3*d*) with broad, spatulate mandible. Oœcium (fig. 3*c*) erect, flattened in front, on which is a semicircular area punctured (not grooved) round the border.

Habitat.—Station 304, lat. 46° 53′ S., long. 75° 11′ W., 45 fathoms, sand (parasitic on a Sertularian).

(26) *Cellepora conica*, n. sp. ? (Pl. XXVIII. fig. 10, and Pl. XXXVI. fig. 1).

? *Cellepora avicularis*, Smitt, Florid. Bryoz. p. 53, pl. ix. figs. 193–197.

Character.—Zoarium in small conical lobes; 0″·125 to 0″·16, disposed more or less in a stelliform manner. Zoœcia with a slightly rugose surface, and in the very young ones obscurely punctured. Orifice clithridiate, peristome rather thick, sometimes raised on one or both sides. A cylindrical short curved pre-oral rostrum, with a terminal avicularium, with a semicircular mandible. A few interspersed retentive avicularia of small size, with spatulate mandible. Oœcia small spherical, deeply immersed, punctured all over.

Habitat.—Simon's Bay, Cape of Good Hope (parasitic on a Sertularian).

I have little doubt that this is the young state of the form described by Prof. Smitt (*loc. cit.*) as *Cellepora avicularis*, but I much doubt whether it is identical with the *Cellepora avicularis* of Hincks, which is of much larger growth, and consequently it is not the *Cellepora avicularis*, Smitt, as represented in specimens from Spitzbergen, which latter is Mr. Hincks' species.

(27) *Cellepora ansata*, n. sp. (Pl. XXX. fig. 4, and Pl. XXXVI. fig. 17).

Character.—Zoarium in the form of small stellate growths or tufts, having three or four conical, pointed divisions. Zoœcia deeply immersed at the base, but more free and erect above; surface shining, rugose. Orifice circular, notched; peristome in the older zoœcia produced in front and on the sides into a long, tubular or rather canalicular process, which supports on each side a small avicularium with a semicircular mandible. Numerous interspersed retentive avicularia, with curved, spatulate, membranous mandible.

Habitat.—Station 75, lat. 38° 37′ N., long. 28° 30′ W., 450 fathoms, sand (parasitic on a small Sertularian ?)

(28) *Cellepora canaliculata*, n. sp. (Pl. XXX. fig. 5, and Pl. XXXVI. fig. 16).

Character.—Zoarium pisiform. Zoœcia ventricose, tolerably distinct; surface rough, entire. Orifice orbicular and notched in front, or more usually clithridiate. A strong curved pre-oral rostrum, from which a thin expansion is continued on each side of the mouth so as to form a spacious spout-like cavity, at the bottom of which the mouth is situated; on the posterior aspect of the rostrum, near the summit, is an avicularium with a semicircular mandible; the apical portion of the process is cylindrical.

Habitat.—Station 48, lat. 43° 2′ N., long. 64° 2′ W., 51 fathoms, rock.

(29) *Cellepora bidenticulata* (Pl. XXX. fig. 6, and Pl. XXXVI. fig. 6).

Character.—Zoarium small, pisiform. Zoœcia ventricose, walls thin, sparsely punctured. Orifice (fig. 6*a*) subclithridiate, with two very minute denticles within the lower border; peristome in the older zoœcia (fig. 6*b*) raised on one side into a thin canalicular expansion and on the opposite side into a thicker process which supports on its inner face a rather large avicularium, with a triangular, obtuse mandible.

Habitat.—Station 163B, off Port Jackson, 35 fathoms, hard ground (parasitic on a Sertularian).

Var. *a. subæqualis* (Pl. XXXVI. fig. 11) (chitinous parts).

Habitat.—Station 162, off East Moncœur Island, Bass Strait, 38 fathoms, sand and shells.

Differs from the form represented in the specimens from Station 163A in the smaller size of the operculum, which is pretty nearly of the same dimensions as the oral avicularian mandible.

(30) *Cellepora granum*, Hincks (Pl. XXXVI. fig. 10) (chitinous parts).

Cellepora granum, Hincks, Ann. and Mag. Nat. Hist., ser 5, vol. viii. p. 68, pl. iii. fig. 8, 1881.

Character.—Zoœcia ovoid, smooth, distant. Orifice suborbicular with a pointed sinus; peristome raised all round and produced in front into a median rostrum supporting an avicularium on its inner face. Oœcia globose, smooth, with semicircular perforated area in front. A few interspersed retentive avicularia, with a broad, spatulate and cucullate mandible.

Habitat.—Station 162, off East Monœur Island, Bass Strait, 38 fathoms, sand and shells.

[Off Curtis Island, abundant, Hincks.]

Only one or two small specimens, in poor condition, occur in the collection, but sufficient to show that in all probability they represent Mr. Hincks' form, in whose figure the peculiar position of the oœcium is well shown.

(31) *Cellepora tubulosa*, Hincks (sp. ?).

Cellepora costazii, var. *a*, *tubulosa*, Hincks, Brit. Mar. Polyz., vol. i. p. 411, pl. lv. fig. 13.

Character.—Zoarium globose; zoœcia of two forms, one ventricose, immersed below, primary orifice pyriform, peristome thin, even with the surface; the other having the peristome much produced and tubular, a cylindrical hollow process on each side which supports at the apex a small avicularium, with an acutely pointed mandible. Secondary orifice large, subquadrangular, the border undulated, one face of the tubular process hollowed, the other rounded. Oœcia recumbent, with a circular finely punctate area on the upper face, placed near the base of the tubular process on the hinder (?) aspect, and above it usually a large triangular opening. Surface generally smooth and entire. Operculum pyriform, pointed below, with an even margin; avicularian mandible subacicular or acuminate.

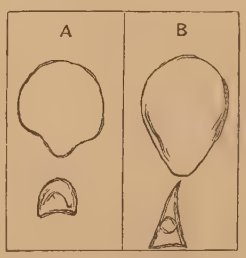


Fig. 59.—A. Operculum and mandible of *Cellepora hassallii*. B. Operculum and mandible of *Cellepora tubulosa*.

Habitat.—Stations 135A and C, Nightingale and Inaccessible Islands, Tristan da Cunha, 75 and 110 fathoms.

Though it is by no means certain that the form here described is identical with Mr. Hincks' var. *a* of *Cellepora costazii* seu *hassallii*; there can be no doubt that the two are very closely allied, nor that they stand in close relation to the form figured by Savigny (Egypte, pl. vii. fig. 4), whether that be identical with the British *Cellepora hassallii*, as Mr. Hincks supposes, or not. At the same time it is quite clear that *Cellepora tubulosa* is distinct from the typical *Cellepora hassallii*, with which I have carefully compared it.

Leaving out of the question the tubular production of the peristome and the globose pisiform habit, &c., the differences in the chitinous elements alone are quite sufficient to show their specific distinctness. In *Cellepora tubulosa* the operculum is simply pyriform, exactly corresponding with the orifice, whilst in *Cellepora hassallii* it is suborbicular with a short peduncular projection below corresponding to the abrupt emargination of the lower border of the orifice; and the avicularian mandibles in the former are acutely pointed or subacicular and in the latter semicircular, as in the great majority of Cellepores.

Family XXXIII. Selenariadæ.

Selenariadæ, Brit. Mus. Cat., part I. p. 97.
Selenaridea, Manzoni.
Escharidæ (pars), d'Orb.
Cellariæa (pars), Blainv.
Membraniporidæ and *Microporidæ* (sp.), Smitt.

Character.—Zoarium orbicular or irregular in outline, convex on one side, plane or concave on the other, in the mature state probably free, often with a foreign particle central or eccentric on the concave face. Zoœcia immersed, flustrine.

The Family here contains the following genera:—

1. *Cupularia*, Lamouroux.
   (1) *Cupularia guineensis*, Busk (Pl. XIV. fig. 6).
   (2) *Cupularia monotrema*, n. sp. (Pl. XIV. fig. 5).
   (3) *Cupularia owenii*, Gray.
2. *Lunularia*, Lamouroux (*nom. mut.*)
   (1) *Lunularia capulus*, Busk (Pl. XIV. fig. 7).

1. *Cupularia*, Lamouroux.

Cupularia, Lamx., Brit. Mus. Cat., p. 97.
Lunulites (pars), Defrance & Auctt.
Fenestella (pars), Lonsdale.

Character.—Each zoœcium having a vibracularium at its apex.

(1) *Cupularia guineensis*, Busk (Pl. XIV, fig. 6).

Cupularia guineensis, Bk., Brit. Mus. Cat., I., p. 98, pl. cxiv.

Character.—Zoarium orbicular, in section crescentic; area rhomboidal, orifice ovoid, not extending to the summit; lamina and raised border finely granular, edge of aperture entire. Vibracular opening auricular, with small elevation on one side. Under surface, with shallow radial sulci, ridges quite flat, divided into moveable quadrangular areas, each of which has four or five shallow pits.

Habitat.—Station 186, lat. 10° 30′ S., long. 142° 18′ E., 8 fathoms, coral sand.

[New Guinea; Philippine Islands, Voy. of Rattles.]

A single dead specimen, but not worn. In the Brit. Mus. Cat. the dorsal surface is described and figured as being divided into hexagonal areas, and the surface as verrucose. But in the older condition, probably, as in the Challenger specimen, the dorsal surface is very finely sulcate, and the areas into which it is subdivided are more or less quadrangular, but in most parts of unequal size. The pits with which the areas are furnished appear to be quite shallow, but they may represent occluded pores, in which case the dorsal aspect would bear some resemblance to that of *Cupularia canariensis*, Busk. In other respects, however, the distinction between the two species is sufficiently obvious.

(2) *Cupularia monotrema*, n. sp. (Pl. XIV. fig. 5).

Character.—Zoarium orbicular, depressed, about 0″·5 in diameter. Area pyriform; orifice linear narrow, with entire edges. Oral valve epidermic, elongated hippocrepian, broad at the base. Vibracular opening large, auricular, with a large tooth on one side, and a rather wide sinus. Occasionally a zoœcium is converted into a prominent avicularium with an acuminate mandible pointing downwards, and a wide cup-shaped beak. Dorsal surface divided into square areas, each with a central perforation.

Habitat.—Off Bahia, 10 to 20 fathoms.

This form is distinguished from all its congeners known to me by the circumstance that many zoœcia are transformed into avicularia. The only specimen is covered with its epidermis or epitheca, so that the exact conformation of the lamina cannot be seen, but it would appear to be of an elongated narrow shape. The oral valve as shown in the figure is placed quite at the summit of the zoœcium; it is surrounded by a thick chitinous frame, and is not articulated to any part of the calcareous skeleton. The peculiar characters of the dorsal surface cannot be seen unless the epidermic covering be removed, as shown in the figure.

(3) *Cupularia owenii*, Gray, sp.

Lunulites owenii, Gray, Spicilegia Zool., pt i. p. 8, pl. iii. fig. 15.
Cupularia owenii, Bk., Brit. Mus. Cat., II. p. 99, pl. cxv.
„ *denticulata* (?), Conrad; Lonsdale; Bk., Crag Polyzoa, p. 85, pl. xiii. fig. 1.
Lunulites alveolatus (?), S. Wood, Ann. and Mag. Nat. Hist., vol. xiii. p. 18.

Habitat.—St. Vincent, Cape Verde Islands, 11 fathoms, mud.
[Coast of Africa; Canaries, M'Andrew.]

2. *Lunularia*, Lamouroux (*nomen mutatum*).

Lunulites, Lamouroux, 1821, Brit. Mus. Cat., part i. p. 100; (pars) Lamarck, Defrance, &c.

Character.—Zoœcia disposed in series, radiating from the centre and bifurcating as they advance towards the border; the vibracularia lying in linear series, alternating with those of the zoœcia. The chitinous vibraculum usually bifid or trifid at the extremity.

In order to avoid the confusion attending the name *Lunulites*, which has usually been understood, by the older writers at any rate, more as a family than as a generic appellation, and is moreover more suitable, in conformity with general usage, for fossil forms, I propose to change it for *Lunularia*, the termination of which is also more in accordance with the other genera in the same family.

(1) *Lunularia capulus*, Busk (Pl. XIV. fig. 7).

Lunulites capulus, Bk., Brit. Mus. Cat., vol. i., p. 100, pl. cxii., and Voy. of Rattles., I., pl. i. figs. 13, 14.

Character.—Zoarium rounded, conical, much raised; area semilunar or arched above, and straight below with a small bifid denticle within the margin (sometimes not seen); margin granular; vibracula trifid at the extremity. Dorsal surface grooved; ridges punctured with a single row of pores.

Habitat.—Station 161, off Port Philip, 33 fathoms, sand.

[Off Cape Capricorn, Voy. of Rattles.]

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PLATE I.

PLATE I.

Catenicella.

PAGE

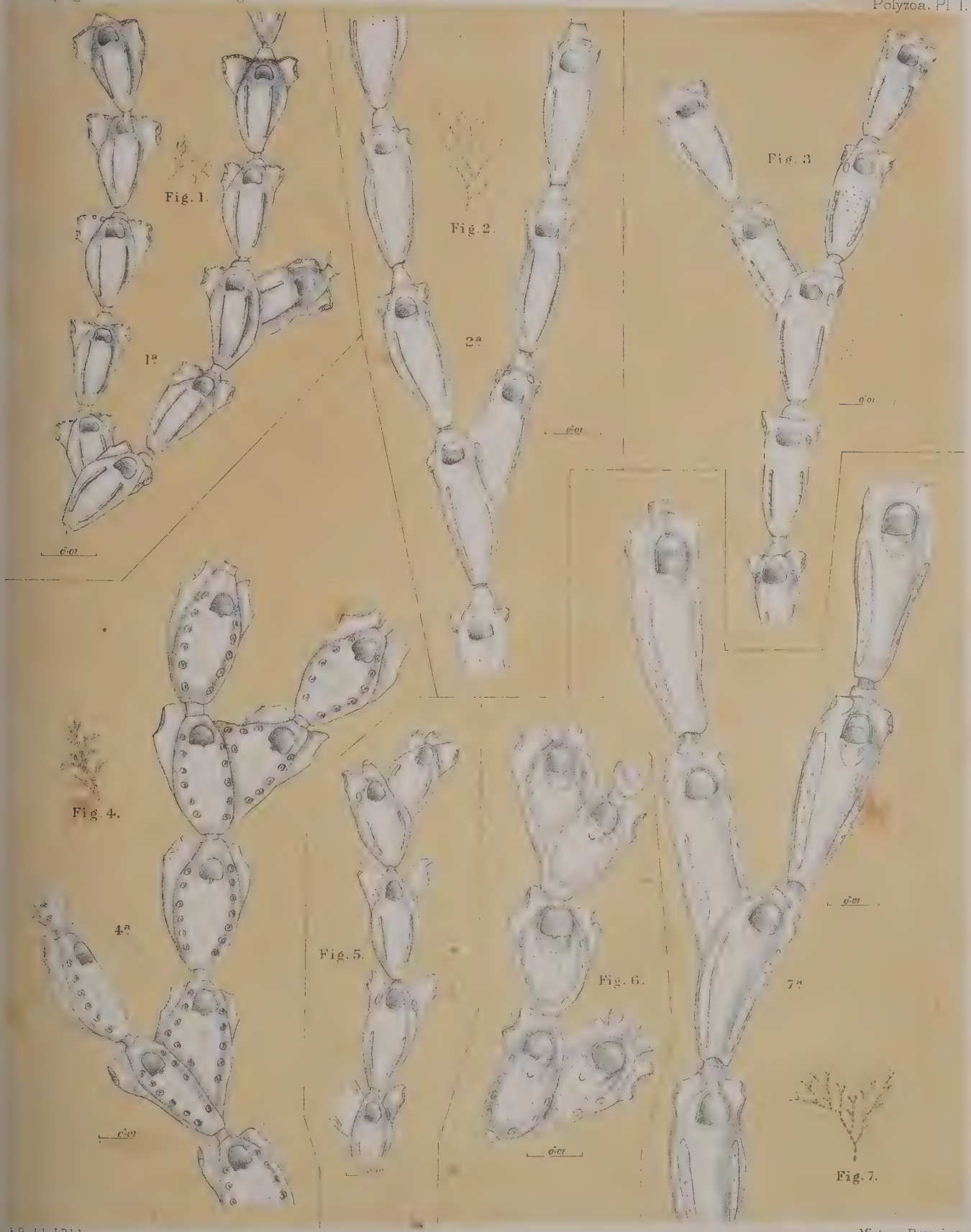
Figure 1.—*Catenicella umbonata*, ... 13
1*a*, magnified.

„ 2, 3, 5.—*Catenicella elegans*, ... 12
2*a*, 3, 5, magnified.

„ 4.—*Catenicella pulchella*, ... 13
4*a*, magnified.

„ 6.—*Catenicella cribraria*, ... 11

„ 7.—*Catenicella sacculata*, ... 12
7*a*, magnified.



J.B. del J.Bth

Mintern Bros, imp.

1. CATENICELLA UMBONATA. 2. 3. 5. C. ELEGANS.
4. C. PULCHELLA. 6. C. CRIBRARIA. 7. C. SACCULATA.

PLATE II.

PLATE II.

CATENARIA.—CELLULARIA.

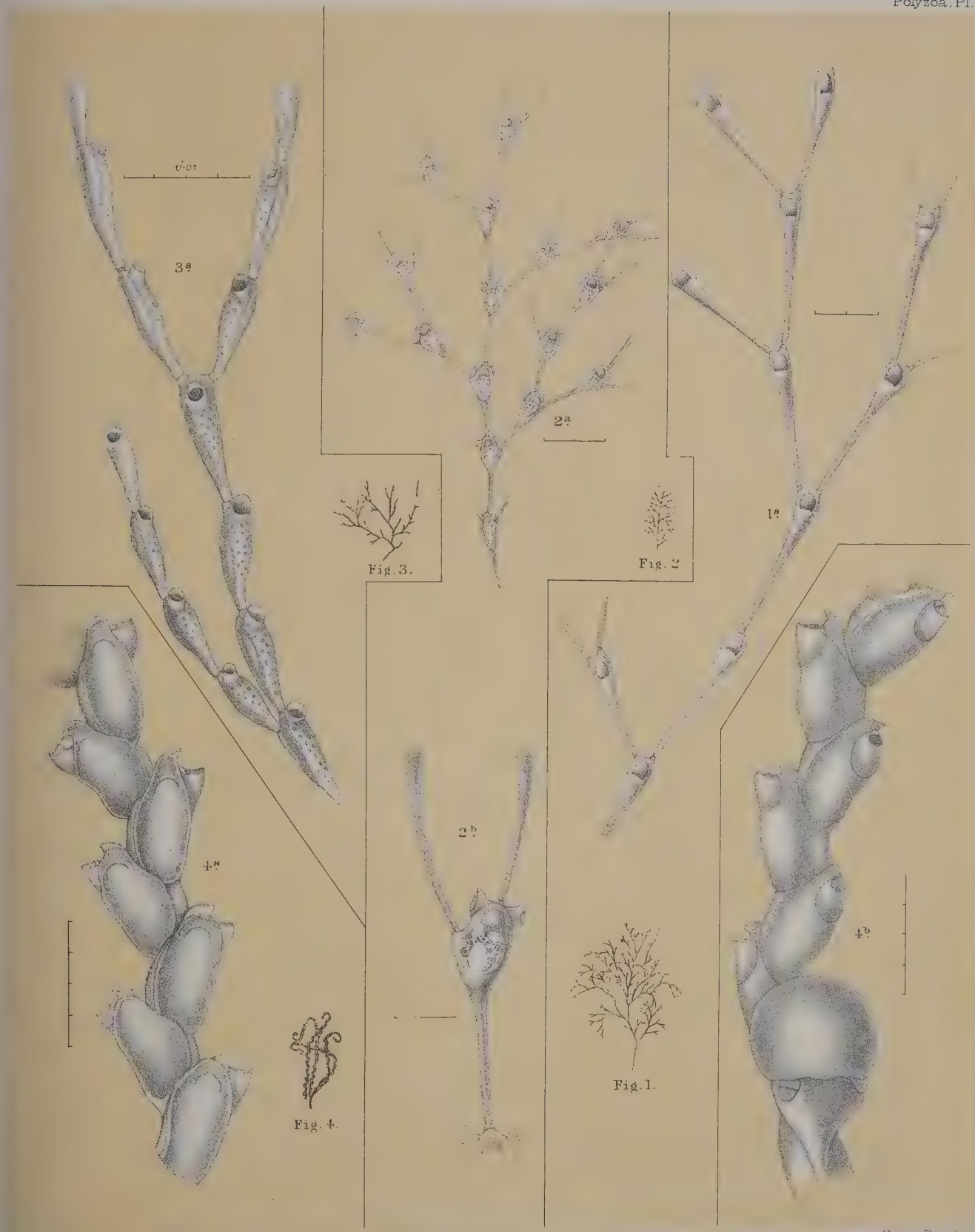
PAGE

Figure 1.—*Catenaria attenuata*, ... 14
1*a*, magnified.

„ 2.—*Catenaria bicornis*, ... 14
2*a*, magnified; 2*b*, more highly magnified.

„ 3.—*Catenaria diaphana*, ... 14
3*a*, magnified.

„ 4.—*Cellularia cirrata*, ... 17
4*a*, magnified; 4*b*, with oœcium.



C B del. C Berjeau lith

M.nteru Bros imp

1. CATENARIA ATTENUATA. 2. C. BICORNIS.
3. C. DIAPHANA 4. CELLULARIA CIRRATÆ

PLATE III.

PLATE III.

Cellularia.—Bugula.

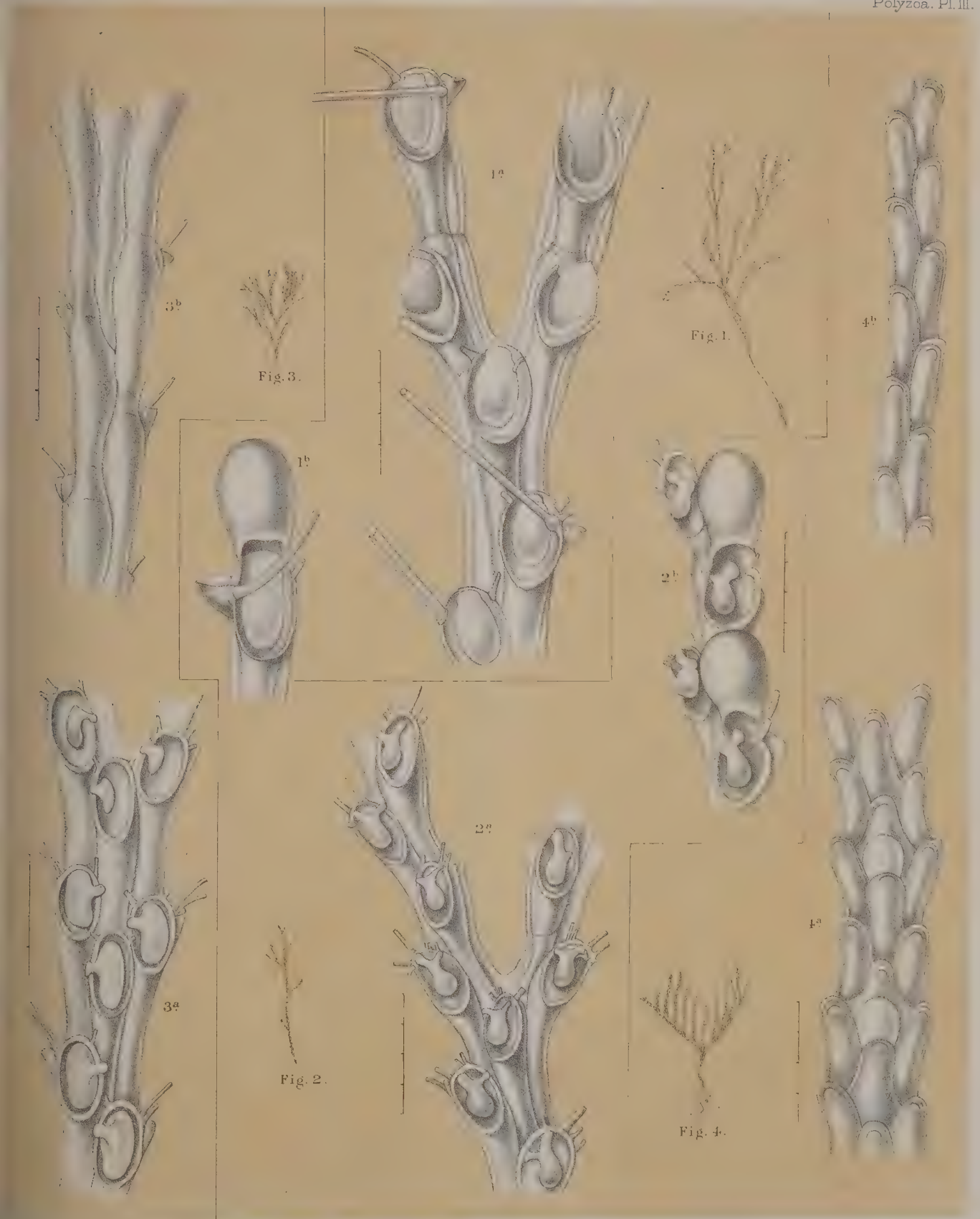
PAGE

Figure 1.—*Cellularia crateriformis*, ... 16
1*a*, magnified; 1*b*, with oœcium.

,, 2.—*Cellularia biloba*, ... 18
2*a*, magnified; 2*b*, with oœcia.

,, 3.—*Cellularia elongata*, ... 19
3*a*, magnified; 3*b*, back view.

,, 4.—*Bugula versicolor*, ... 38
4*a*, magnified; 4*b*, with oœcia.



G B del C Berjeau lith

Mintern Bros, imp.

1. CELLULARIA CRATERIFORMIS. 2. C. BILOBA.
3. C. ELONGATA. 4. BUGULA VERSICOLOR.

PLATE IV.

PLATE IV.

Menipea.

PAGE

Figure 1.—*Menipea flagellifera*, ... 21
1*a*, 1*b*, magnified.

„ 2.—*Menipea aculeata*, ... 20
2*a*, magnified.

„ 3.—*Menipea marionensis*, ... 21
3*a*, magnified (Pl. XIV. fig. 9).

„ 4.—*Menipea benemunita*, ... 19
4*a*, magnified.

„ 5.—*Menipea clausa*, ... 20
5*a*, magnified.

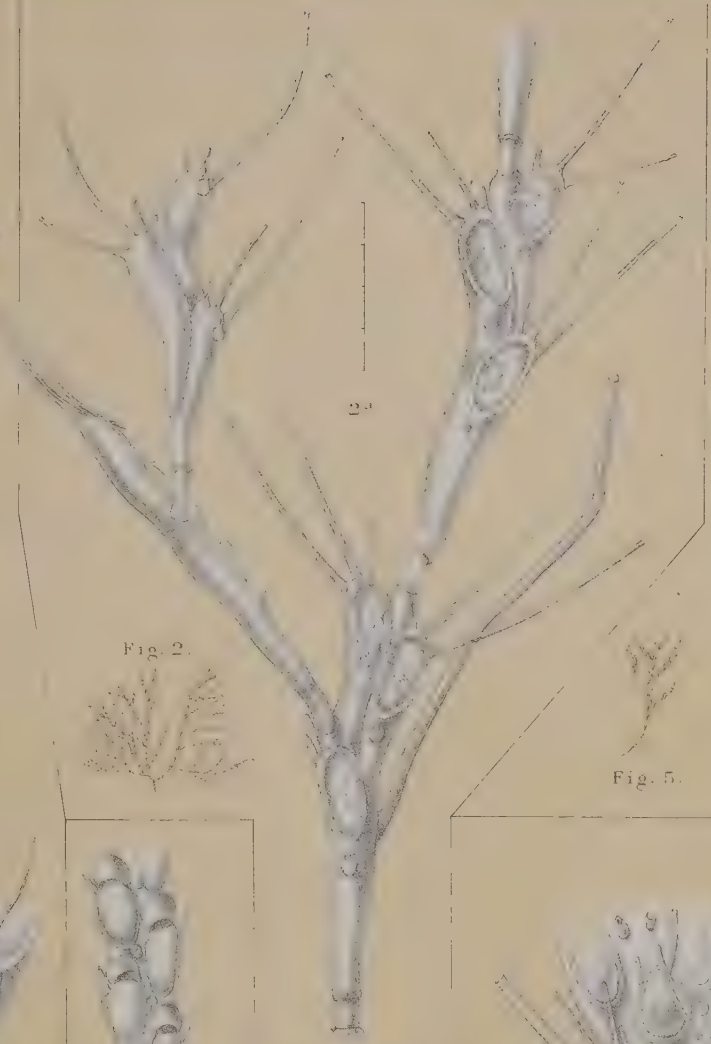


Fig. 2.

Fig. 5.

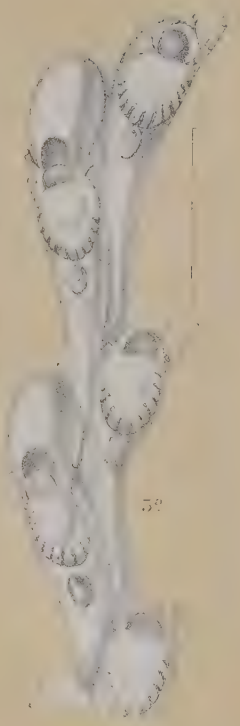


Fig. 1

Fig. 3

Fig. 4.

G.B. del. C. Berjeau lith

Mintern Bros., imp.

1. MENIPEA FLAGELLIFERA. 2. M. ACULEATA.
3. M. MARIONENSIS. 4. M. BENEMUNITA. 5. M. CLAUSA.

PLATE V.

PLATE V.

FARCIMINARIA.—MENIPEA.—CELLULARIA.—NELLIA.

PAGE

Figure 1.—*Farciminaria magna*, ... 49
1*a*, magnified; 1*b*, with oœcia; more highly magnified.

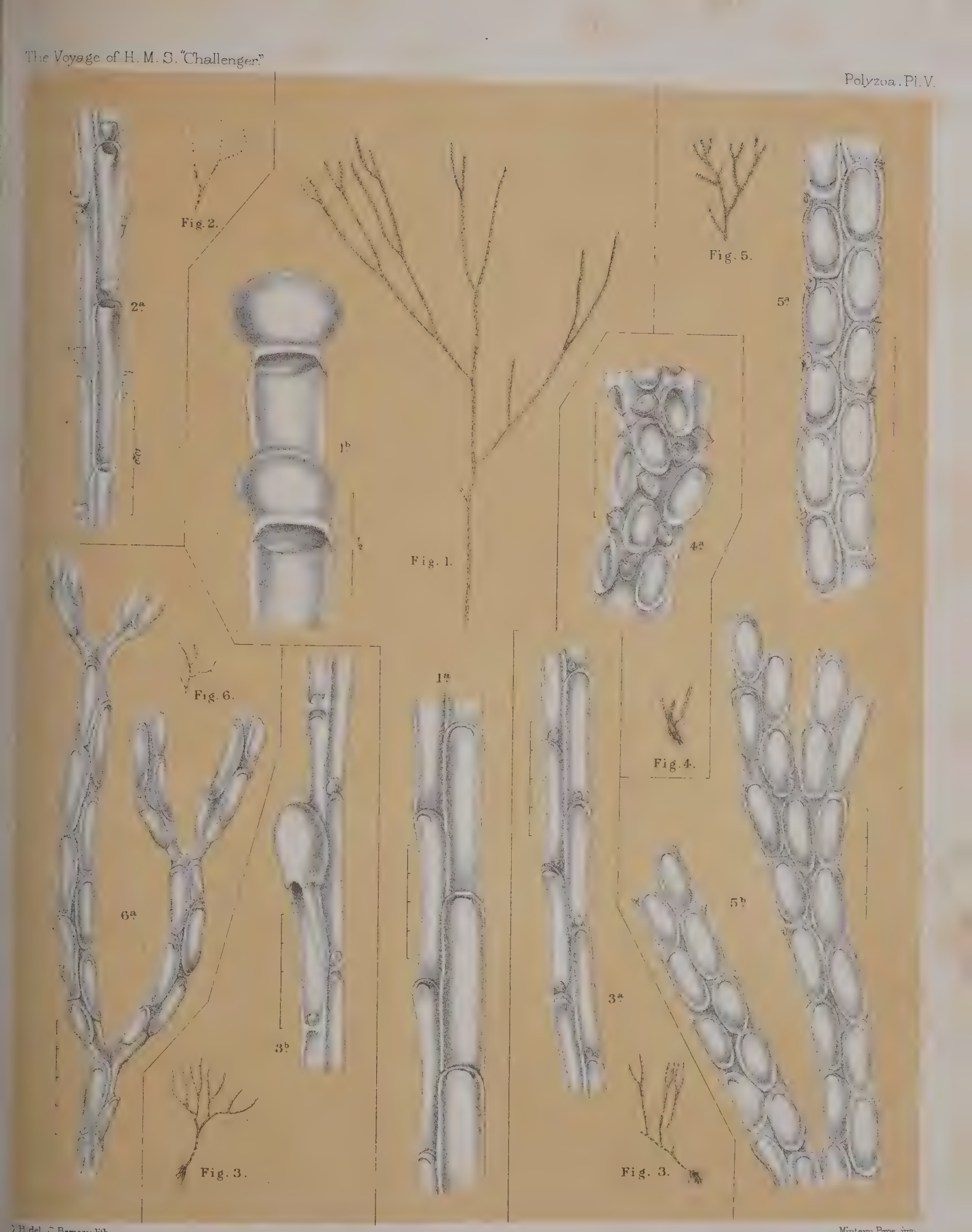
„ 2.—*Farciminaria cribraria*, ... 49
2*a*, magnified.

„ 3.—*Farciminaria gracilis*, ... 51
3*a*, magnified; 3*b*, with oœcium.

„ 4.—*Menipea pateriformis*, ... 22
4*a*, magnified.

„ 5.—*Cellularia quadrata*, ... 18
5*a*, magnified; 5*b*, back view.

„ 6.—*Nellia simplex*, ... 27
6*a*, magnified.



J. B. del. C. Berjeau lith.

Mintern Bros, imp.

1. FARCIMINARIA MAGNA. 2. F. CRIBRARIA. 3. F. GRACILIS.
4. MENIPEA PATERIFORMIS. 5. CELLULARIA QUADRATA. 6. NELLIA SIMPLEX.

PLATE VI.

PLATE VI.

Bicellaria.

PAGE

Figure 1.—*Bicellaria glabra*,[1] 35
1*a*, magnified.

„ 2.—*Bicellaria infundibulata*, ... 33
2*a*, side view, magnified; 2*b*, back view; 2*c*, 2*d*, avicularia, more highly magnified.

„ 3.—*Bicellaria bella*, ... 34
3*a*, oœcium; 3*b*, avicularium.

„ 4.—*Bicellaria moluccensis*, ... 34

[1] Since this plate was printed, Mr. Hincks having described the same form under the name of *Stirparia glabra*, I have adopted his specific appellation.

Fig. 4.

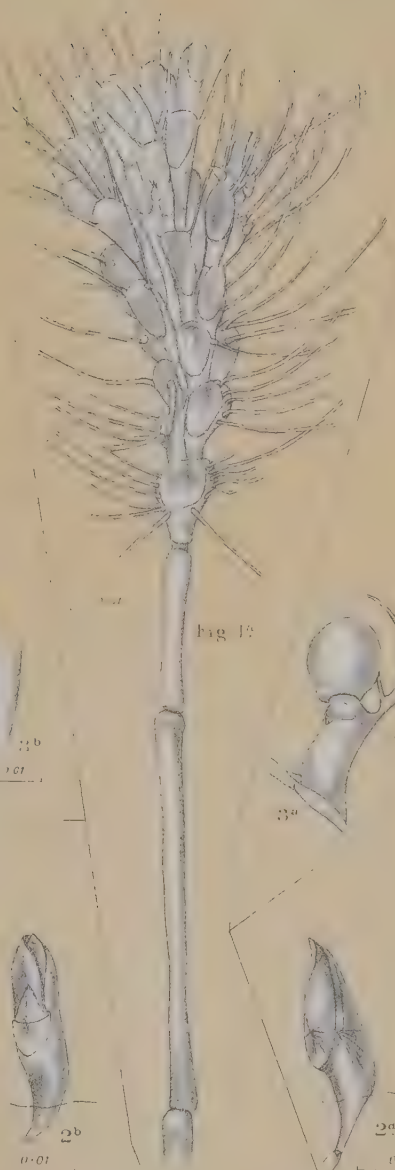


Fig. 12.

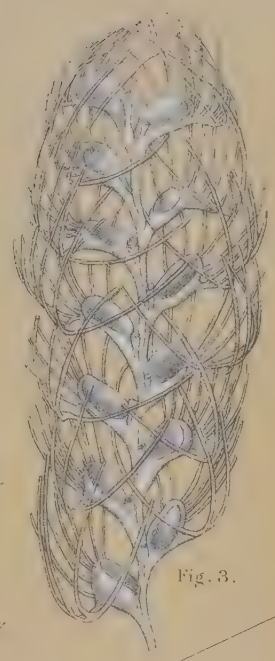
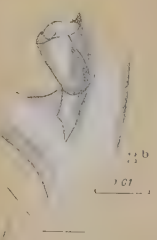


Fig. 3.



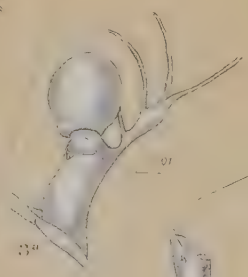


Fig. 2.

Fig. 1.

PLATE VII.

PLATE VII.

Bicellaria.

PAGE

Figure 1.—*Bicellaria pectogemma*,[1] 33
1*a*, magnified; 1*b*, 1*c*, avicularia, more highly magnified.

,, 2.—*Bicellaria naviculoris*, ... 32
2*a*, magnified; 2*b*, oœcium.

[1] Mr. Goldstein having, since the plate was printed several years ago, given another name to this species, I have accordingly adopted it.

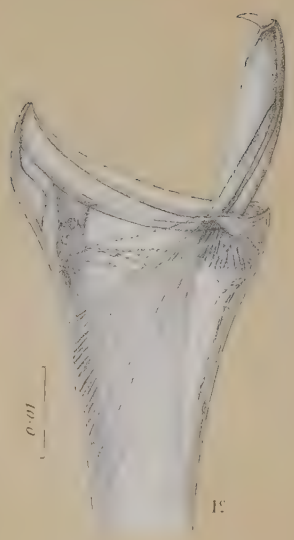


Fig. 1.

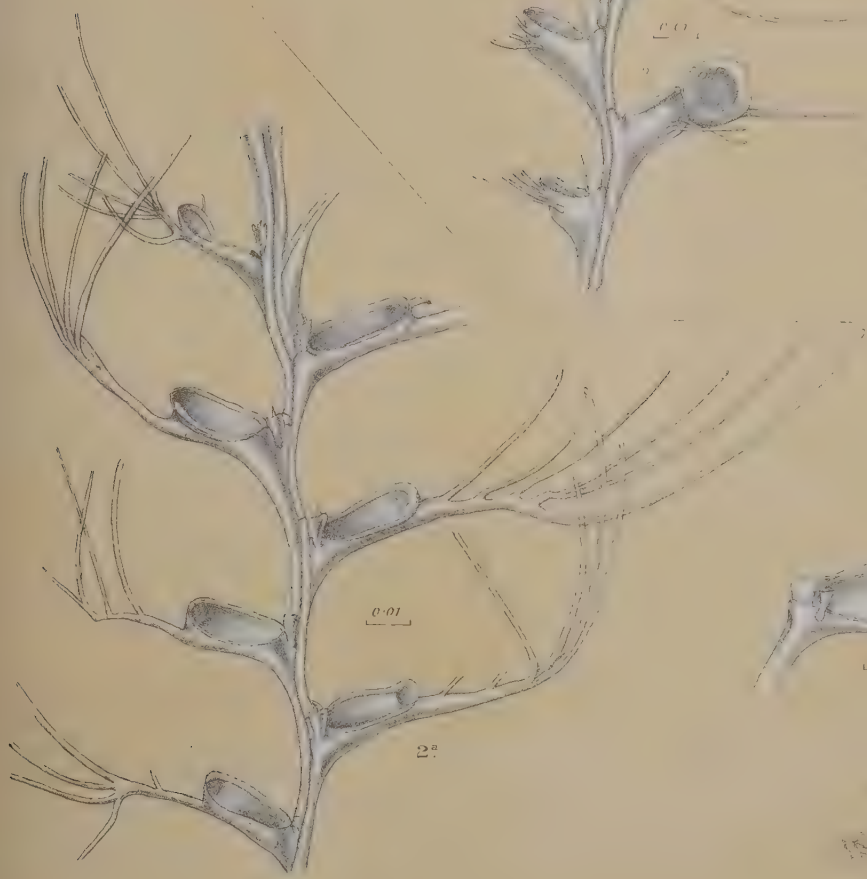


Fig. 2.

1. BICELLARIA SPATULATA, 2. B. NAVICULARIS.

PLATE VIII.

PLATE VIII.

KINETOSKIAS.—BUGULA.

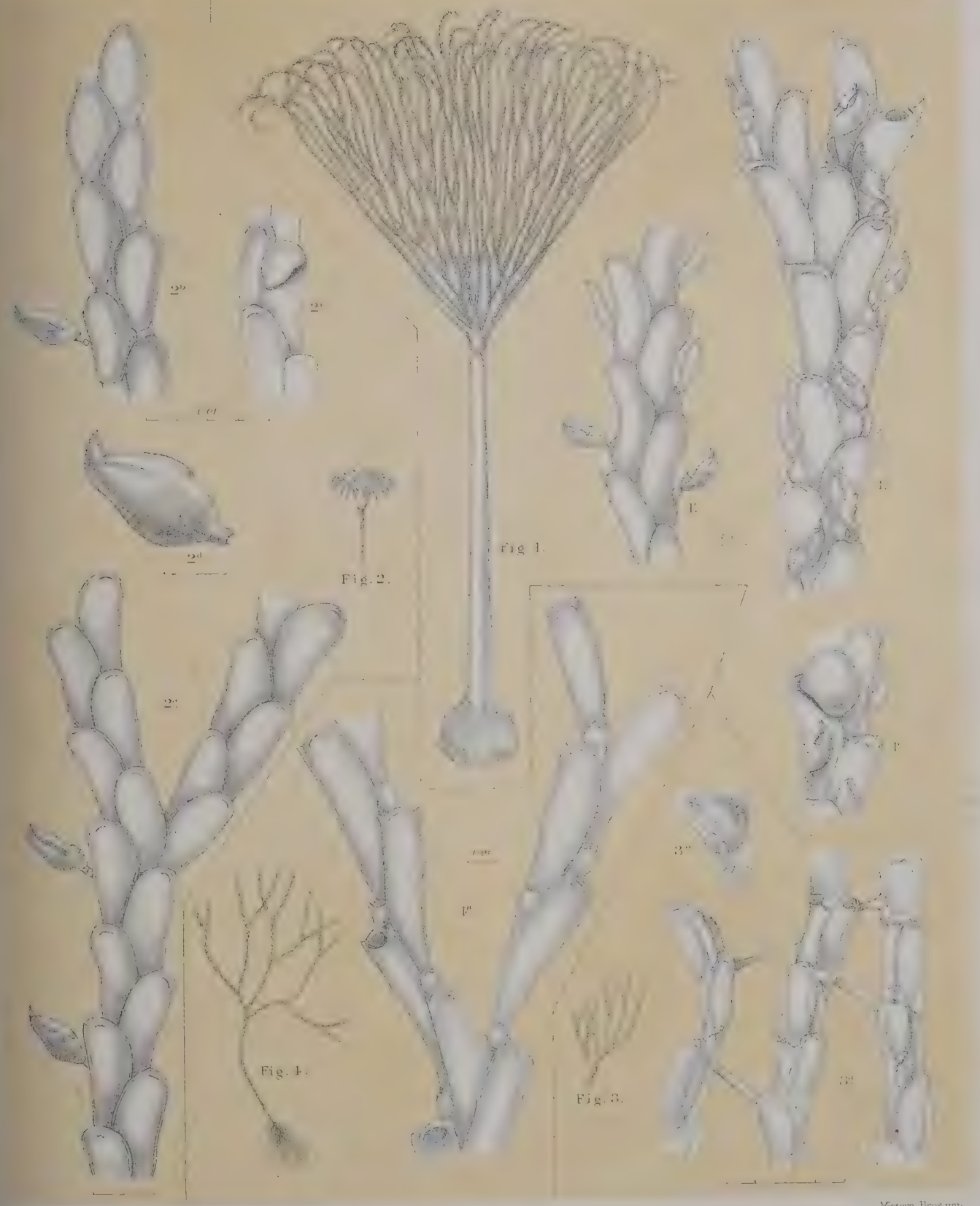
PAGE

Figure 1.—*Kinetoskias cyathus* (after Sir C. Wyville Thomson), . . 44
1*a*, magnified; 1*b*, back view; 1*c*, oœcium.

„ 2.—*Kinetoskias pocillum*, ... 45
2*a*, magnified; 2*b*, back view; 2*c*, oœcium; 2*d*, avicularium, more highly magnified.

„ 3.—*Bugula reticulata*, ... 40
3*a*, magnified; 3*b*, avicularium.

„ 4.—*Bugula margaritifera*, ... 41
4*a*, magnified.



J.E. ad. del. Berjeau lith

Mintern Bros imp.

1. KINETOSKIAS CYATHUS. 2. K. POCILLUM.
3. BUGULA RETICULATA. 4. B. MARGARITIFERA.

PLATE IX.

PLATE IX.

Bugula.

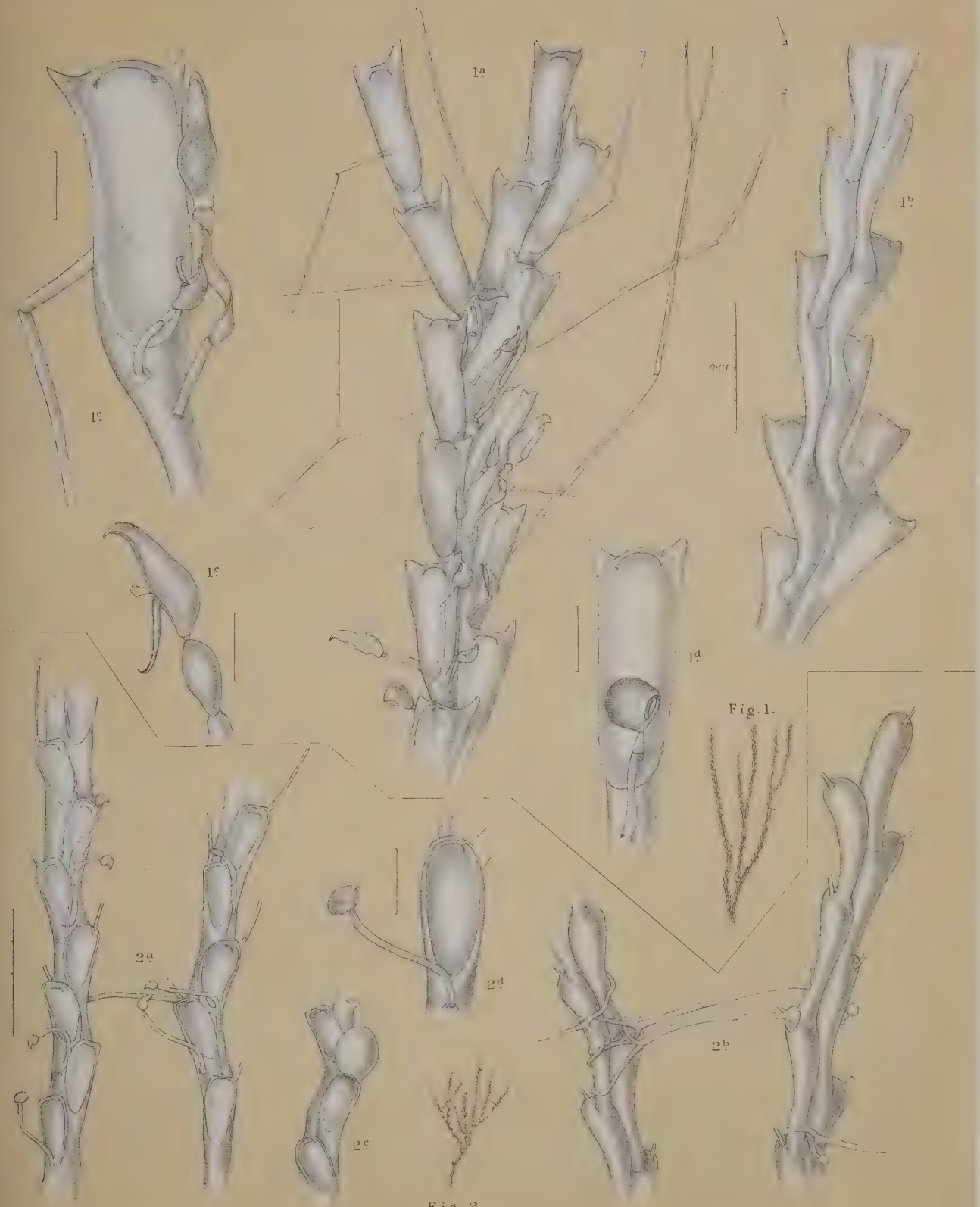
PAGE

Figure 1.—*Bugula bicornis*, ... 40

1*a*, magnified; 1*b*, back view; 1*c*, two avicularia and radical tube; 1*d*, smaller avicularium arising close below the aperture; 1*e*, larger avicularium, showing the digitiform process.

,, 2.—*Bugula reticulata*, var. *unicornis*, ... 40

2*a*, magnified; 2*b*, back view; 2*c*, oœcium; 2*d*, avicularium.



M. & N. del. C. Berjeau lith.

Mintern Bros. imp.

1. BUGULA BICORNIS. 2. B. RETICULATA, *VAR*: UNICORNIS.

PLATE X.

PLATE X.

Bugula.—Onchopora.

PAGE

Figure 1.—*Bugula mirabilis*, ... 39
1*a*, upper or triserial portion; 1*b*, lower or biserial portion.

„ 2.—*Bugula sinuosa*, ... 39
2*a*, magnified; 2*b*, avicularium.

„ 3.—*Bugula leontodon*, ... 39
3*a*, triserial portion; 3*b*, biserial portion.

„ 4.—*Onchopora sinclairii*, ... 103
4*a*, magnified.

Mintern Bros., imp.

1. BUGULA MIRABILIS. 2. B. SINUOSA.
3. B. LEONTODON. 4. ONCHOPORA SINCLAIRII.

PLATE XI.

PLATE XI.

CABEREA.—SCRUPOCELLARIA.

PAGE

Figure 1.—*Caberea crassimarginata*, ... 28
1*a*, magnified; 1*b*, back view.

„ 2.—*Scrupocellaria securifera*, ... 24
2*a*, magnified; 2*b*, back view.

„ 3.—*Caberea lata*, ... 30
3*a*, magnified.

„ 4.—*Scrupocellaria macandrei*, ... 23
4*a*, magnified; 4*b*, back view.

„ 5.—*Scrupocellaria ciliata*, ... 23
5*a*, magnified.

„ 6.—*Scrupocellaria ornithorhynchus*, ... 24
6*a*, magnified; 6*b*, back view.

„ 7.—*Scrupocellaria pilosa*, ... 24
7*a*, magnified.

J. B. del. C. Berjeau lith.

Mintern Bros., imp.

1. CABEREA CRASSIMARGINATA. 2. SCRUPOCELLARIA SECURIFERA. 3. CABEREA LATA.
4. SCRUPOCELLARIA MACANDREI. 5. S. CILIATA. 6. S. ORNITHORHYNCHUS. 7. S. PILOSA.

PLATE XII.

PLATE XII.[1]

Salicornaria.

PAGE

Figures 1, 5, 7.—*Salicornaria malvinensis,** 91
1*a*, 1*b*, 5*a*, 7*a*, magnified.

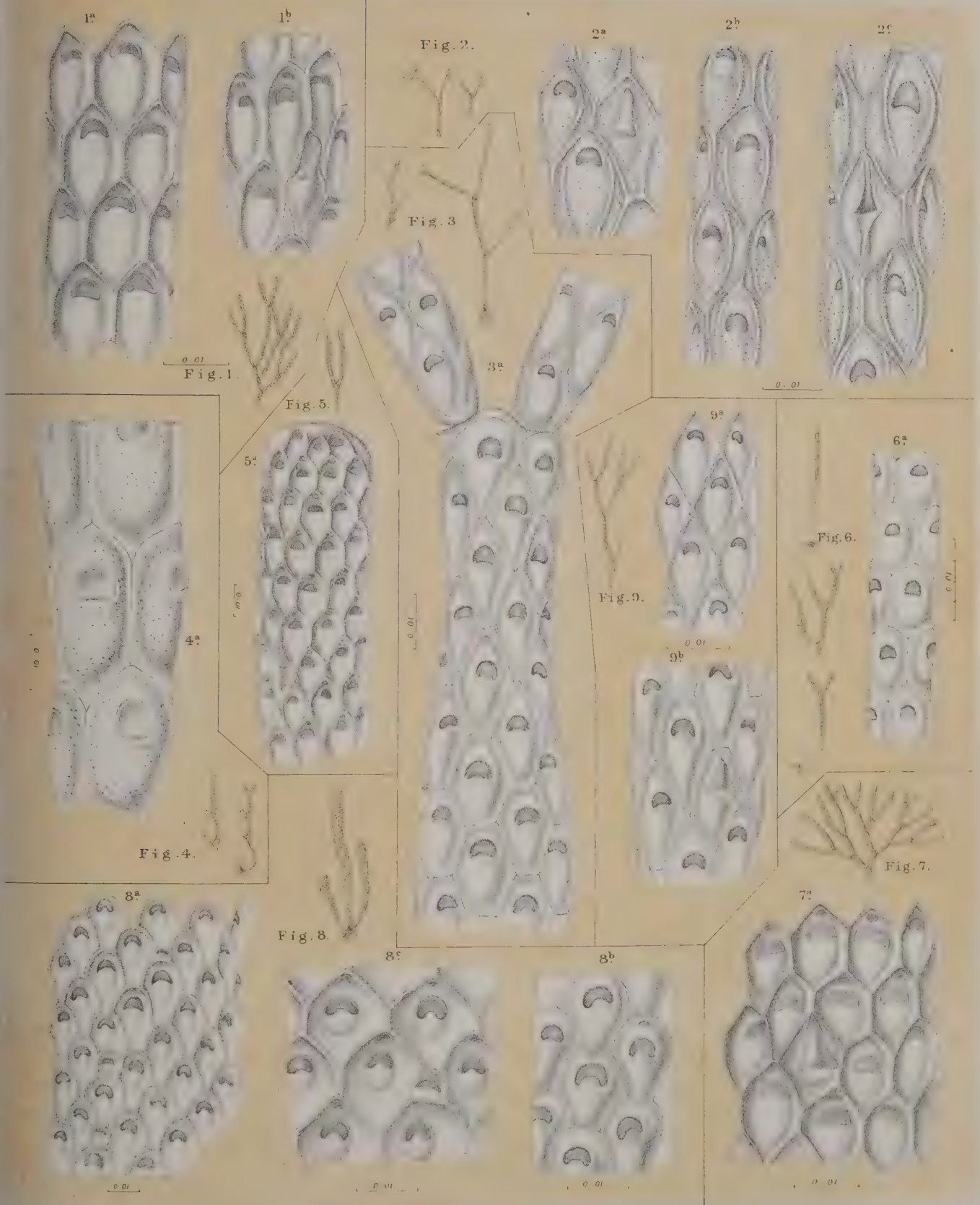
„ 2.—*Salicornaria dubia,** 91
2*a*, 2*b*, 2*c*, magnified.

„ 3, 9.—*Salicornaria variabilis*, ... 89
3*a*, 9*a*, 9*b*, magnified.

„ 4, 6.—*Salicornaria magnifica*, ... 93
4*a*, 6*a*, magnified.

„ 8.—*Salicornaria clavata*, ... 88
8*a*, magnified; 8*b*, 8*c*, more highly magnified.

[1] The species thus marked (*) have been re-named since the plate was printed off.



GB del. C Berjeau lith

Mintern Bros imp.

1. SALICORNARIA MALVINENSIS. 2 S. TENUIROSTRIS. 3 & 9. S. VARIABILIS.
4 & 6. S. MACNIFICA. 5 & 7. S. MEGASTOMA. 8. S. CLAVATA.

PLATE XIII.

PLATE XIII.

BIFAXARIA.—ICHTHYARIA.

PAGE

Figure 1.—*Bifaxaria submucronata*, ... 80
1*a*, magnified.

,, 2.—*Bifaxaria lævis*, ... 80
2*a*, magnified; 2*b*, back view.

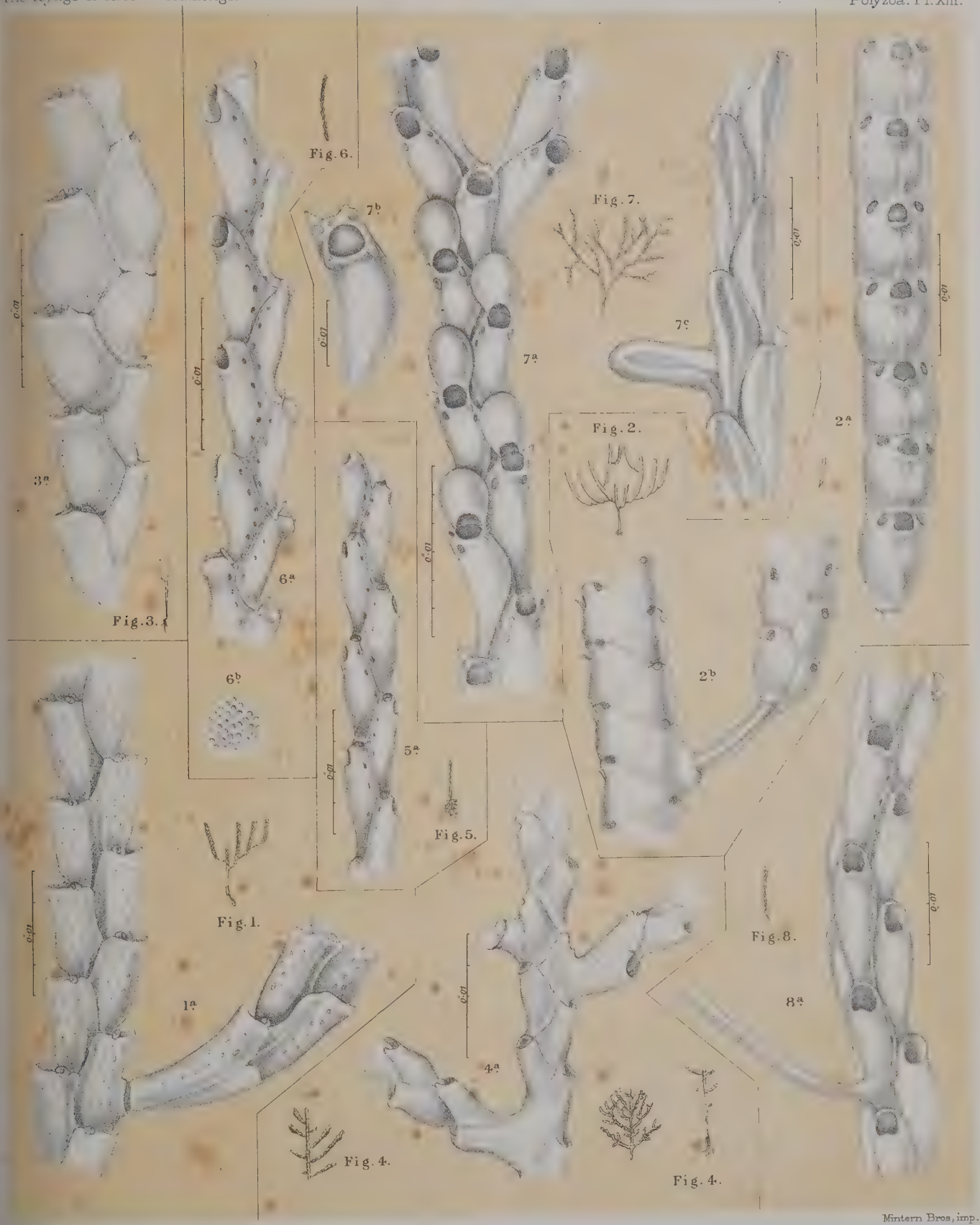
,, 3.—*Bifaxaria corrugata* (Pl. XXIV. fig. 6), ... 80
3*a*, magnified.

,, 4.—*Bifaxaria papillata* (Pl. XXIV. fig. 4), ... 81
4*a*, magnified.

,, 5.—*Bifaxaria minuta*, ... 81
5*a*, magnified.

,, 6, 8.—*Bifaxaria reticulata*, ... 82
6*a*, 8*a*, magnified; 6*b*, portion of zoœcial wall, more highly magnified.

,, 7.—*Ichthyaria oculata*, ... 46
7*a*, magnified; 7*b*, a single zoœcium, more highly magnified;
7*c*, back view.



G.B. del. C. Berjeau lith. Mintern Bros, imp.

1. BIFAXARIA SUBMUCRONATA. 2. B. LÆVIS. 3. B. CORRUGATA.
4. B. PAPILLATA. 5. B. MINUTA. 6. 8. B. RETICULATA. 7. ICTHYARIA OCULATA.

PLATE XIV.

PLATE XIV.

MELICERITA.—BIFLUSTRA.—MEMBRANIPORA.—FOVEOLARIA.—CUPULARIA, &c.

PAGE

Figure 1.—*Melicerita atlantica*, ... 96
1*a*, magnified.

„ 2.—*Biflustra savartii*, ... 67
2*a*, magnified.

„ 3.—*Membranipora crassimarginata*,[1] 63
3*a*, section showing interzoercial pores, "Rosettenplatten."

„ 4.—*Foveolaria tubigera*, ... 68
4*a*, magnified; 4*b*, avicularium; 4*c*, trumpet-shaped process.

„ 5.—*Cupularia monotrema*, ... 207
5*a*, magnified; 5*b*, back view.

„ 6.—*Cupularia guineensis*, ... 206
6*a*, magnified; 6*b*, back view.

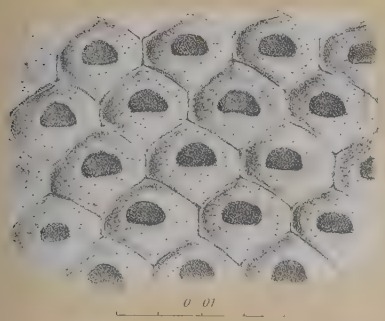
„ 7.—*Lunularia capulus*, ... 208
7*a*, magnified; 7*b*, back view.

„ 8.—*Canda simplex*, ... 26

„ 9.—*Menipea marionensis* (Pl. IV. fig. 3), ... 21

„ 10.—*Farciminaria hexagona*, showing the two series of uninhabited zoœcia (Pl. XXXI. fig. 3), ... 51

[1] *B* at foot of plate should be *M*.



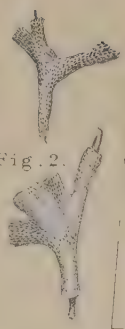


Fig. 2.

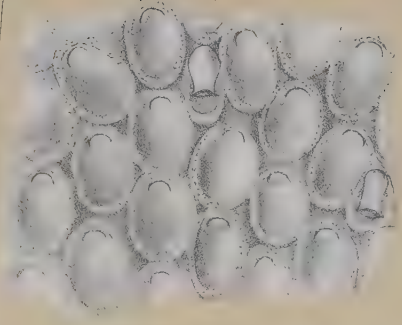


Fig. 1

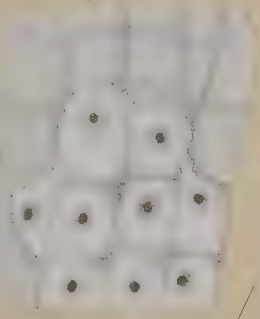


Fig. 8.

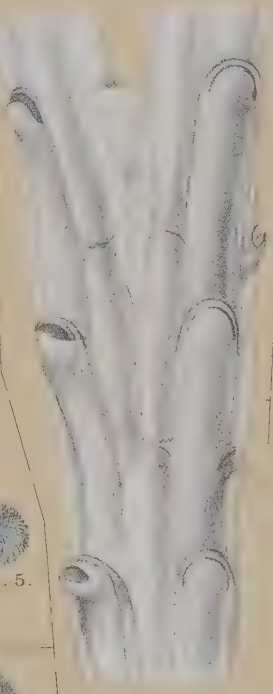


Fig. 5.

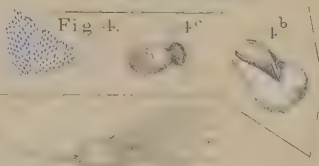
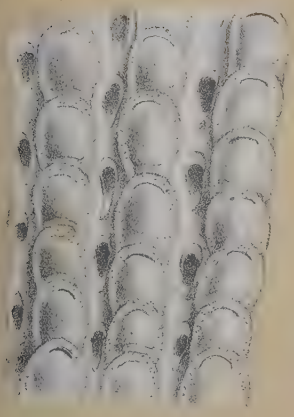
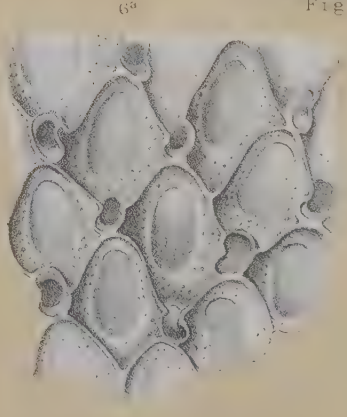


Fig. 9.

Fig. 7.

Fig. 6.





G.H. de. C. Bernea, lith.

Mintern Bros. imp.

1. MELICERITA ATLANTICA. 2. BIFLUSTRA SAVARTII. 3. B. CRASSIMARGINATA.
4. FOVEOLARIA TUBIGERA. 5. CUPULARIA MONOTREMA. 6. C. GUINIENSIS.
7. LUNULARIA CAPULUS. 8. CANDA SIMPLEX. 9. MENIPEA MARIONENSIS.
10. FARCIMINARIA HEXAGONA.

PLATE XV.

PLATE XV.[1]

AMPHIBLESTRUM.—SIPHONICYTARA.—MEMBRANIPORA.—FOVEOLARIA.—MICROPORA.

PAGE

Figure 1.—*Amphiblestrum cristatum,** 65
1*a*, 1*b*, 1*c*, cells with oœcia showing the various avicularia; 1*d*, sterile zoœcium.

„ 2.—*Siphonicytara serrulata*, ... 101
2*a*, magnified; 2*b*, back view, with radical tubes.

„ 3.—*Amphiblestrum imbricatum,** 65
3*a*, magnified; 3*b*, avicularium.

„ 4.—*Membranipora albida*, ... 63
4*a*, magnified.

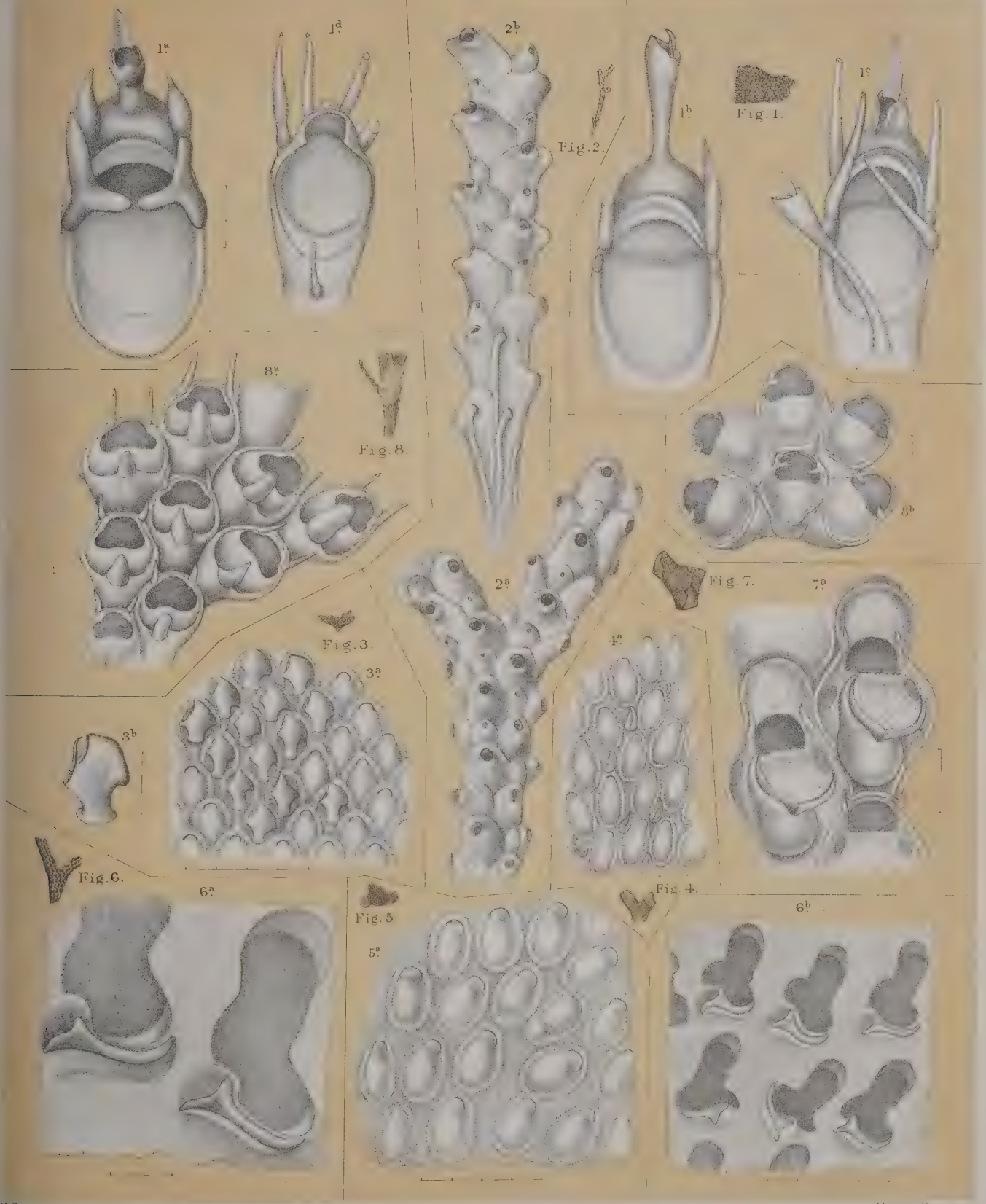
„ 5.—*Membranipora crassimarginata*, var. *incrustans,** 63
5*a*, magnified.

„ 6.—*Foveolaria falcifera*, ... 69
6*a*, 6*b*, magnified.

„ 7.—*Micropora uncifera*, ... 71
7*a*, magnified.

„ 8.—*Amphiblestrum umbonatum,** 66
8*a*, 8*b*, magnified.

[1] The species thus marked (*) have been re-named since the plate was printed off.



G.B. del. C. Berjeau lith.

Mintern Bros. imp.

1. MEMBRANIPORA CRISTATA. 2. SIPHONICYTARA SERRULATA. 3. MEMBRANIPORA IMBRICATA.
4. M. ALBIDA. 5. BIFLUSTRA CRASSIMARGINATA. 6. FOVEOLARIA FALCIFERA.
7. MICROPORA UNCIFERA. 8. MEMBRANIPORA UMBONATA.

PLATE XVI.

PLATE XVI.

FLUSTRA.—DIACHORIS.—CARBASEA.

PAGE

Figure 1.—*Flustra biseriata*, ... 54
1*a*, magnified.

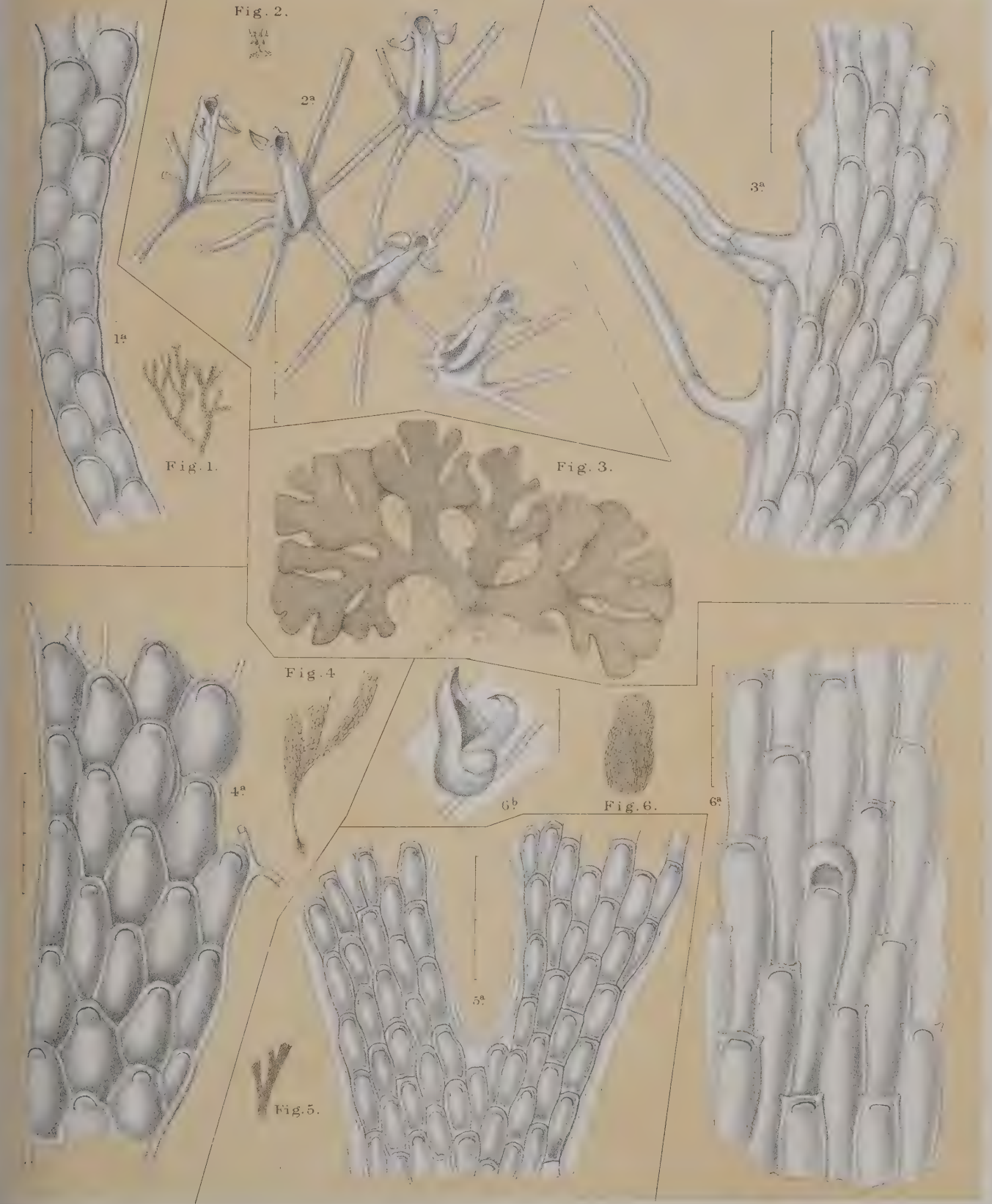
,, 2.—*Diachoris magellanica*, var. *distans*, ... 59
2*a*, magnified.

,, 3.—*Carbasea ovoidea*, ... 55
3*a*, magnified.

,, 4.—*Carbasea pedunculata*, ... 56
4*a*, magnified.

,, 5.—*Carbasea elegans*, ... 56
5*a*, magnified.

,, 6.—*Flustra crassa*, ... 53
6*a*, magnified; 6*b*, avicularium.



C B ae. C Berjeau lith

Mintern Bros. imp.

1. FLUSTRA BISERIATA. 2. DIACHORIS MAGELLANICA, *VAR.* DISTANS.
3. CARBASEA OVOIDEA. 4. C. PEDUNCULATA. 5. C. ELEGANS. 6. FLUSTRA CRASSA.

PLATE XVII.

PLATE XVII.[1]

SCHIZOPORELLA.—SMITTIA.—LEPRALIA.—CRIBRILINA.—MUCRONELLA.

PAGE

Figure 1.—*Schizoporella nivea*, ... 163
1*a*, magnified.

,, 2.—*Schizoporella longispinata*, ... 163
2*a*, magnified; 2*b*, single zoœcium, more highly magnified; 2*c*, oœcium.

,, 3.—*Smittia smittiana*, ... 151
3*a*, magnified; 3*b*, oœcium.

,, 4.—*Lepralia celleporoides*, ... 142
4*a*, magnified; 4*b*, more highly magnified.

,, 5.—*Lepralia japonica*, ... 143
5*a*, magnified.

,, 6.—*Cribrilina philomela*, ... 132
6*a*, magnified; 6*b*, oœcium.

,, 7.—*Lepralia tuberosa*, ... 143
7*a*, magnified; 7*b*, with oœcium; 7*c*, single zoœcium, more highly magnified; 7*d*, back view.

,, 8.—*Mucronella quadrata*[2] (Pl. XVIII. fig. 5), ... 156
8*a*, magnified.

[1] When the plate was prepared all these forms were included under the generic term *Hemeschara*, which has since been discarded in accordance with more modern views.

[2] Altogether misnamed on the plate.

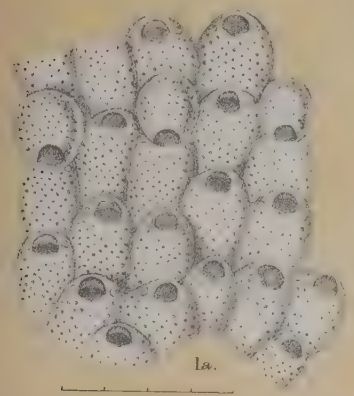
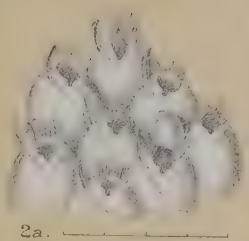


Fig. 1



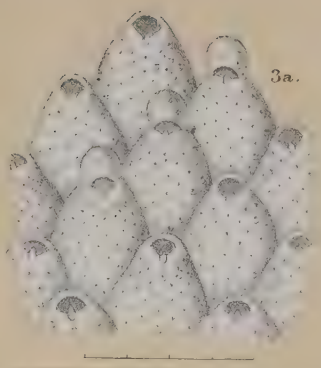
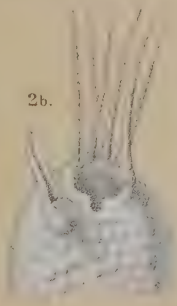
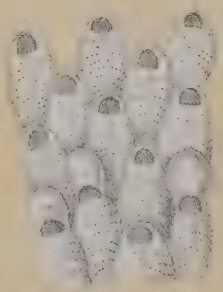


Fig. 3.

Fig. 2.





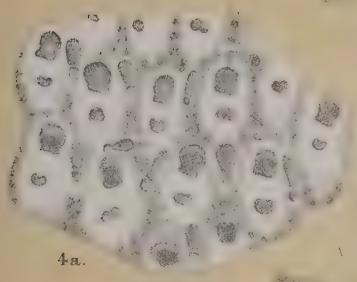


Fig. 4.

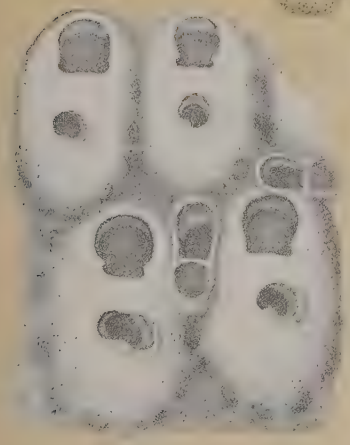


Fig. 5.

Fig. 6.

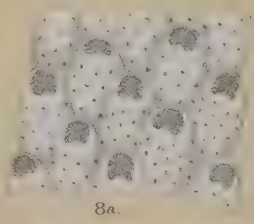
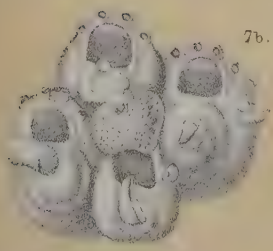
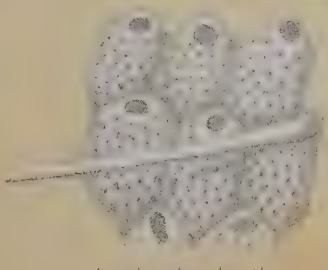
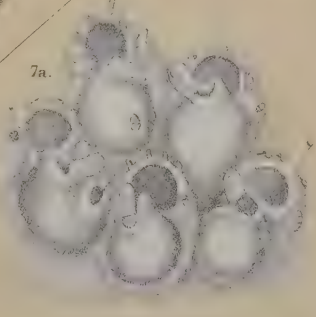


Fig. 8.

Fig. 7.







G B del. C. Berjeau lith.

Mintern Bros., imp.

1. HEMESCHARA NIVEA. 2. H. LONGISPINATA. 3. H. SMITTIANA. 4. H. CELLEPOROIDES.
5. H. JAPONICA. 6. H. PHILOMELA. 7. H. TUBEROSA. 8. H. MONOCEROS.

PLATE XVIII.

PLATE XVIII.[1]

SMITTIA.—MUCRONELLA.—LEPRALIA.

PAGE

Figure 1.—*Smittia marsupialis*, ... 151
1*a*, magnified; 1*b*, oœcium.

„ 2.—*Mucronella delicatula*, ... 156
2*a*, magnified; 2*b*, single zoœcium, more highly magnified.

„ 3.—*Mucronella magnifica*, ... 158
3*a*, magnified; 3*b*, single zoœcium, more highly magnified.

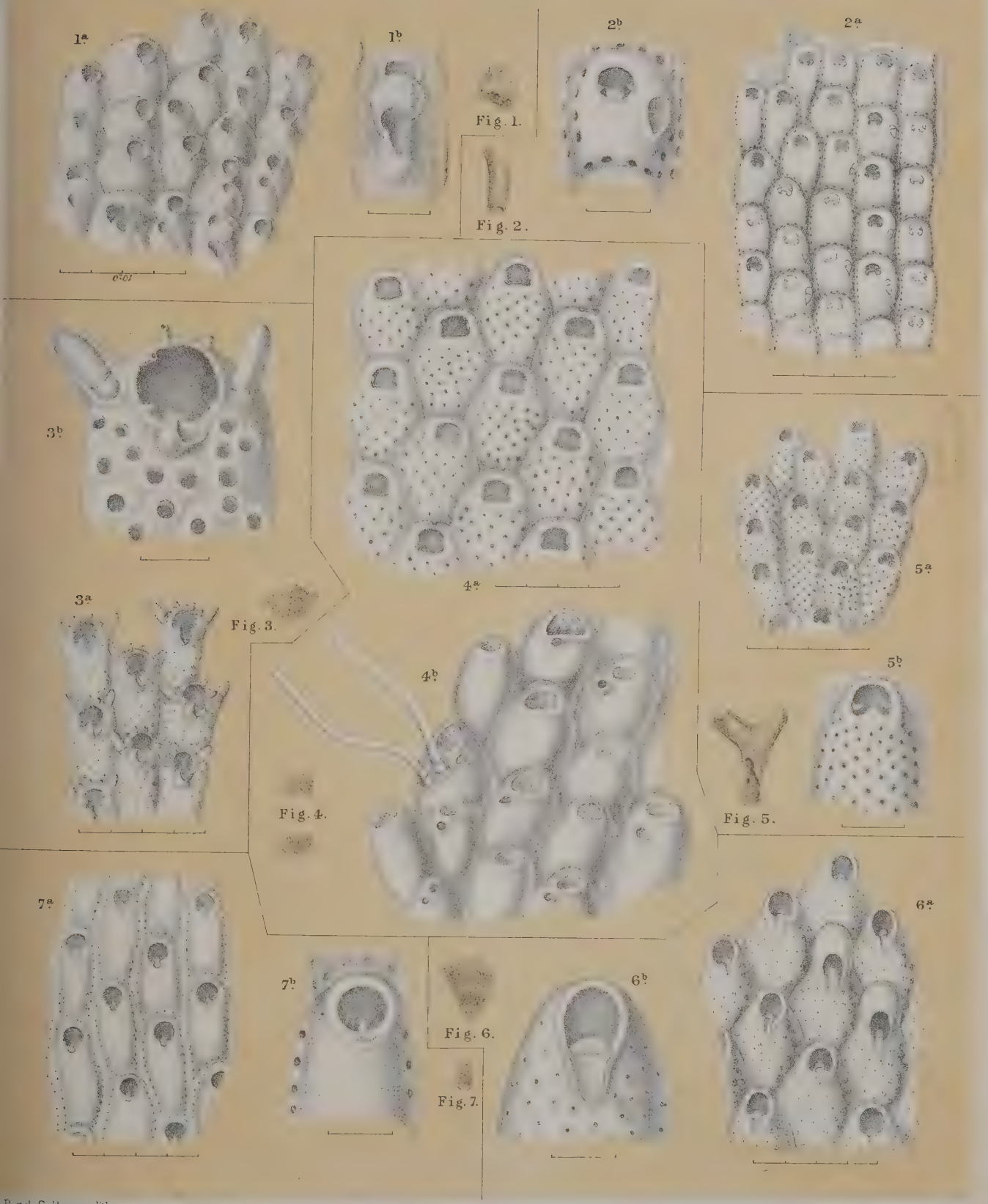
„ 4.—*Lepralia dorsiporosa*, ... 143
4*a*, magnified; 4*b*, back view.

„ 5.—*Mucronella quadrata* (Pl. XVII. fig. 8), ... 156
5*a*, magnified; 5*b*, single zoœcium, more highly magnified.

„ 6.—*Smittia marionensis*, ... 152
6*a*, magnified; 6*b*, single zoœcium, more highly magnified.

„ 7.—*Smittia transversa*, ... 152
7*a*, magnified; 7*b*, single zoœcium, more highly magnified.

[1] *Vide* note to Pl. XVII.



B. del. C. Berjeau lith.

Mintern Bros., imp.

1. HEMESCHARA MARSUPIALIS. 2. H. DELICATULA. 3. H. MAGNIFICA.
4. H. DORSIPOROSA. 5. H. QUADRATA. 6. H. MARIONENSIS. 7. H. TRANSVERSA.

PLATE XIX.

PLATE XIX.[1]

SCHIZOPORELLA.—MUCRONELLA.—CRIBRILINA.—SMITTIA.

PAGE

Figure 1.—*Schizoporella auriculata*, var. *alba*,[2] 164
1*a*, magnified; 1*b*, single zoœcium, more highly magnified.

„ 2.—*Mucronella rostrigera*, ... 156
2*a*, magnified; 2*b*, single zoœcium, more highly magnified.

„ 3.—*Schizoporella jacksoniensis*, ... 164
3*a*, magnified; 3*b*, more highly magnified.

„ 4.—*Cribrilina labiosa*, ... 133
4*a*, magnified; 4*b*, single zoœcium, more highly magnified.

„ 5.—*Mucronella bisinuata*, ... 157
5*a*, magnified; 5*b*, single zoœcium, more highly magnified.

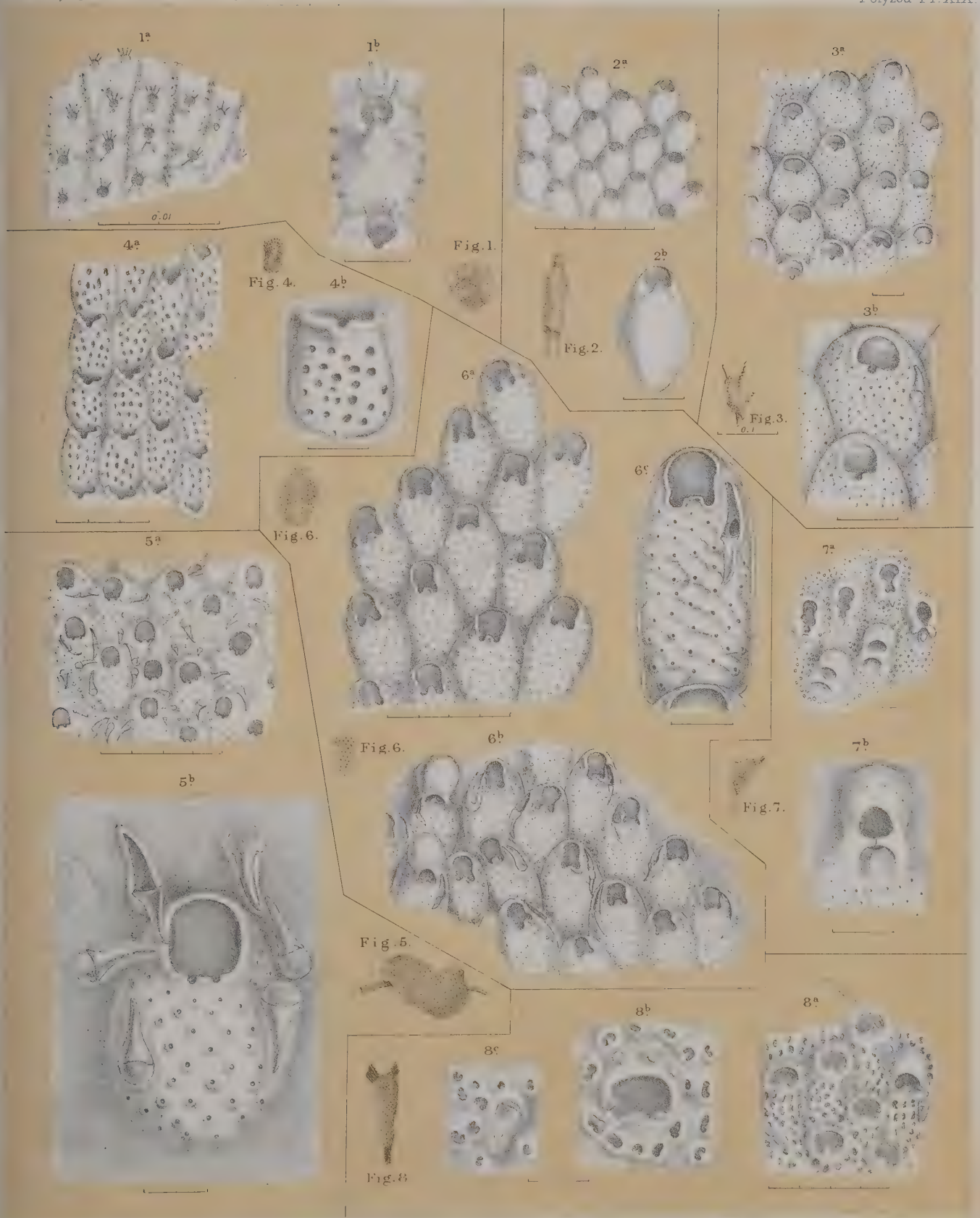
„ 6.—*Mucronella castanea*, ... 157
6*a*, magnified; 6*b*, 6*c*, with avicularia.

„ 7.—*Smittia jacobensis*, ... 153
7*a*, magnified; 7*b*, oœcium.

„ 8.—*Cribrilina monoceros*, ... 133
8*a*, magnified; 8*b*, orifice; 8*c*, avicularium, more highly magnified.

[1] *Vide* note to Pl. XVII.

[2] This name has been changed, but with some doubt as to the correctness of so doing.



G.B. del. C.Berjeau lith. Mintern Bros. imp

1. HEMESCHARA ROSTRIFERA. 2. H. MUCRONATA. 3. H. JACKSONIENSIS. 4. H. CRIBRARIA.
5. H. BISINUATA. 6. H. CASTANEA. 7. H. JACOBENSIS. 8. H. MONOCEROS.

PLATE XX.

PLATE XX.[1]

SMITTIA.—ADEONELLA.—PORELLA.—ESCHARA, &c

PAGE

Figure 1.—*Smittia tenuis*, ... 150
1*a*, magnified; 1*b*, single zoœcium, more highly magnified.

„ 2.—*Adeonella regularis* (woodcut 53), ... 186
2*a*, magnified; 2*b*, single zoœcium, more highly magnified.

„ 3.—*Porella lævis*, var. *subcompressa*, ... 149
3*a*, magnified; 3*b*, single zoœcium, more highly magnified.

„ 4.—*Adeonella distoma*, var. *imperforata*, ... 188
4*a*, magnified; 4*b*, single zoœcium, more highly magnified.

„ 5.—*Mucronella pyriformis*, ... 155
5*a*, 5*b*, magnified.

„ 6.—*Eschara elegantula*, ... 141
6*a*, 6*b*, magnified.

„ 7.—*Adeonella atlantica* (Pl. XXI. fig. 1) (woodcut 52), . . . 186
7*a*, magnified; 7*b*, zoœcia, more highly magnified.

„ 8.—*Flustramorpha marginata*, ... 135
8*a*, magnified; 8*b*, more highly magnified.

„ 9.—*Mucronella contorta*, ... 155
9*a*, magnified; 9*b*, with avicularia; 9*c*, 9*d*, orifice and avicularia, more highly magnified.

„ 10.—*Schizoporella tenuis*, ... 165
10*a*, magnified.

[1] The generic names given above have been substituted for that of *Eschara*, which, as seen in the text, I have now employed in a much more restricted sense.

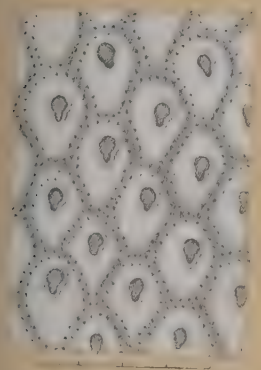
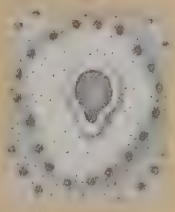

1a.

Fig. 1.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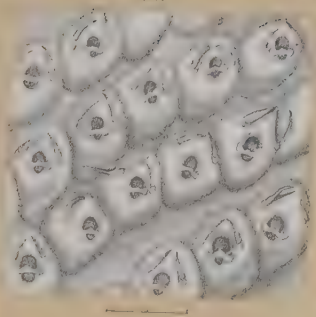
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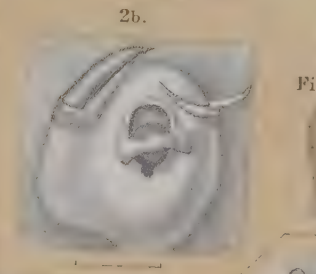
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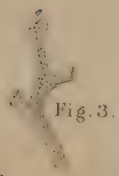
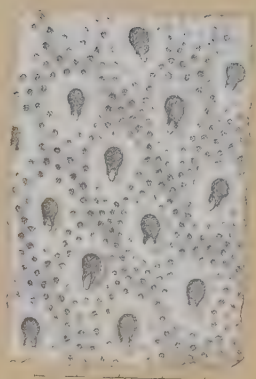


Fig. 3.

3b.



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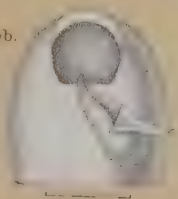
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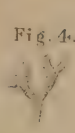


Fig. 4.

Fig. 2.

Fig. 6.

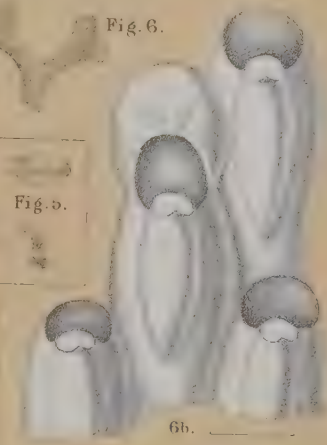

6b.

Fig. 5.

5a.

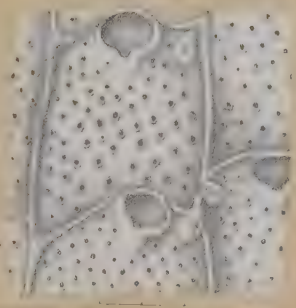
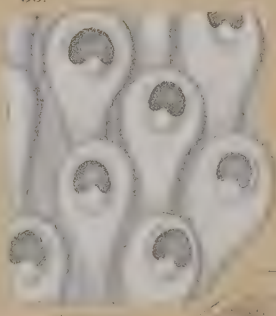

10a.

Fig. 10.

Fig. 9.

7b.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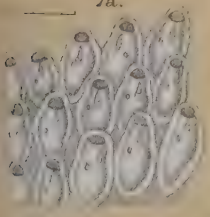
6a.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9a.

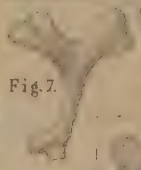


Fig. 7.

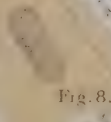


Fig. 8.

Fig. 8.

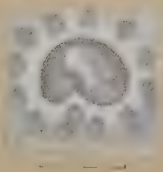
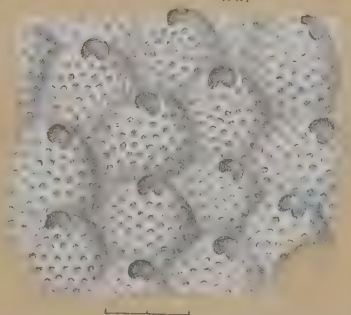
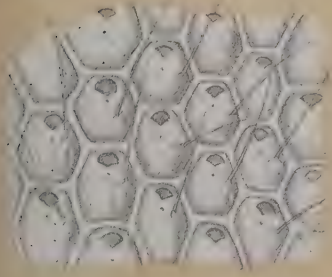

9d.

Fig. 9.


9b.


8a.

8b.

9c.

G.B. del. C. Berjeau lith.

Mintern Bros., imp.

1. ESCHARA TENUIS. 2. E. REGULARIS. 3. E. DOLICHOSTOMA. 4. E SULCATA. 5. E. PYRIFORMIS.
6. E. ELEGANTULA. 7. E. SUBSULCATA. 8. E. FLAGELLIFERA. 9. E. CONTORTA. 10. HEMESCHARA TENUIS.

PLATE XXI.

PLATE XXI.[1]

ADEONELLA.—SCHIZOPORELLA.—ESCHARA.—FLUSTRAMORPHA, &c.

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,,	1*a*, 2*a*, 3.—*Adeonella polymorpha*, ...	183
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	5*a*, magnified.	
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	6*a*, magnified.	
,,	7.—*Flustramorpha hastigera*, ...	136
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,,	8.—*Escharoides occlusa*, ...	150
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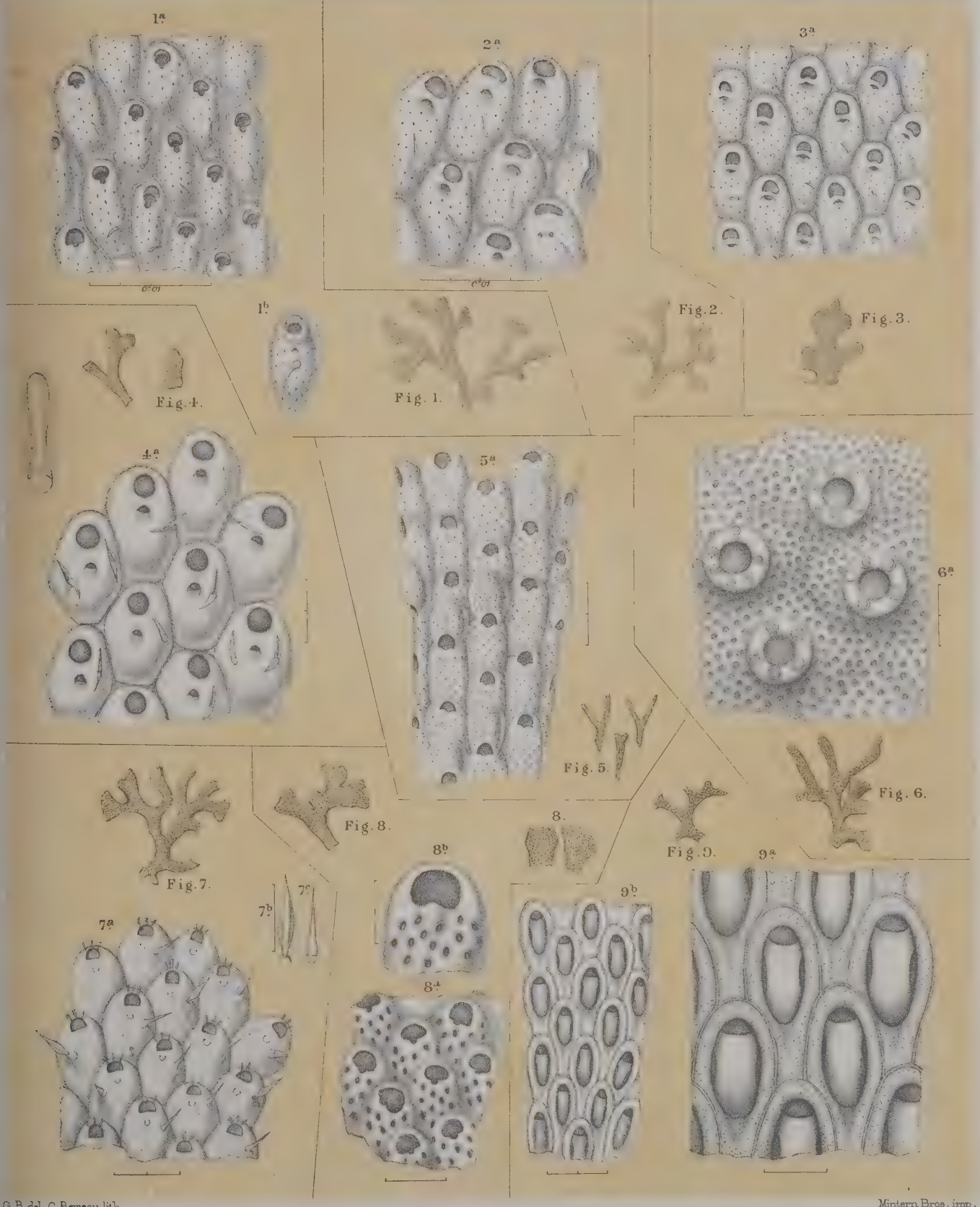
,,	9.—*Caleschara denticulata*, var. *tenuis*, ...	70
	9*b*, magnified; 9*a*, more highly magnified.	

[1] *Vide* note to Pl. XX.



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Mintern Bros, imp.

1. 2. 3. ESCHARA POLYMORPHA. 4. E. TUMIDULA. 5. E. FURCATA.
6. E. CORONATA. 7. E. HASTICERA. 8. E. OCCLUSA. 9. VINCULARIA TENUIS.

PLATE XXII.

PLATE XXII.[1]

SMITTIA.—MUCRONELLA.—LEPRALIA.—CRIBRILINA.—SCHIZOPORELLA.—CHORIZOPORA.

PAGE

Figure 1.—*Smittia oratavensis*, ... 153

„ 2.—*Mucronella canalifera*, ... 159

„ 3.—*Mucronella tricuspis*, ... 159
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„ 4.—*Lepralia hyalina*, var. *bougainvillei*, ... 148

„ 5.—*Mucronella simplicissima*, ... 160

„ 6.—*Smittia stigmatophora*, ... 154

„ 7.—*Cribrilina philomela*, var. *adnata*, ... 132

„ 8.—*Schizoporella elegans*, ... 165
8*a*, operculum.

„ 9.—*Lepralia feegeensis*, ... 144
9*a*, 9*b*, orifice and avicularium; more highly magnified.

„ 10.—*Cribrilina latimarginata*, ... 131

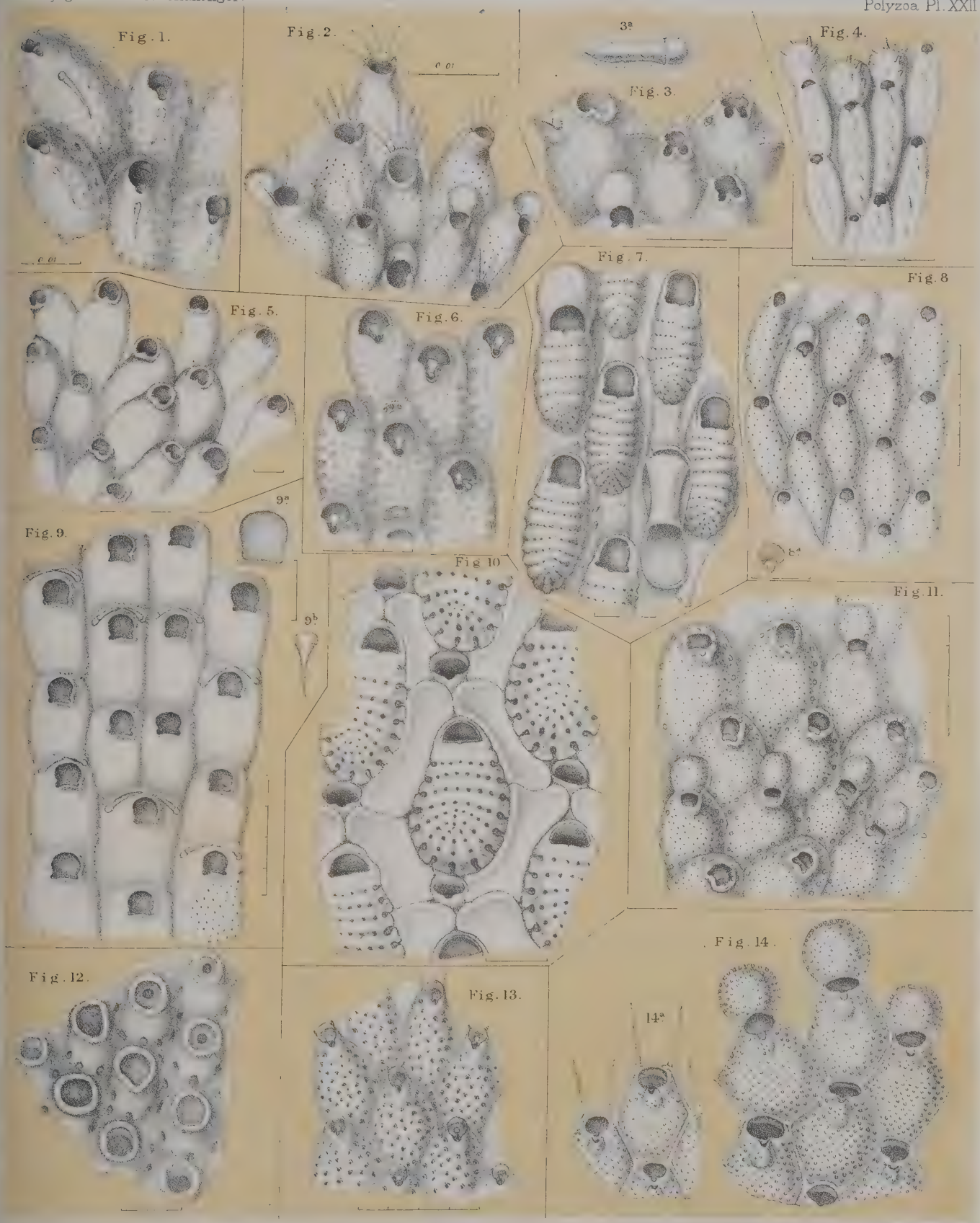
„ 11.—*Mucronella ventricosa*, var. *multispinata*, ... 160

„ 12.—*Chorizopora honolulensis*, ... 148

„ 13.—*Smittia graciosa*, ... 154

„ 14.—*Schizoporella marsupifera*, ... 165
14*a*, orifice, more highly magnified.

[1] *Vide* note to Pl. XX. For similar reasons the term *Lepralia* has been replaced in the above list.



G B del. C Berjeau lith

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1. LEPRALIA OPHIDIANA. 2. L. CANALIFERA. 3. L. COCCINEA. 4. L. HYALINA *VAR:* BOUGAINVILLEI.
5. L. SIMPLICISSIMA. 6. L. STIGMATOPHORA. 7. HEMESCHARA PHILOMELA *(LEPRALIOID FORM.)*
8. L. ELEGANS. 9. L. FEEGEENSIS. 10. L. LATIMARGINATA. 11. L. VENTRICOSA *VAR:* MULTISPINATA.
12. L. HONOLULENSIS. 13. L. GRACIOSA. 14. L. MARSUPIFERA.

PLATE XXIII.

PLATE XXIII.[1]

VINCULARIA.—FOVEOLARIA.—MYRIOZOUM, &c.

PAGE

Figure 1.—*Vincularia gothica*, ... 72
1*a*, magnified; 1*b*, more highly magnified, showing the gradual formation of the bridge across the orifice; 1*c*, slightly magnified portion of young branch in which the cells are quadriserial; 1*d*, transverse section of same.

„ 2.—*Steganoporella magnilabris*,* 75
2*a*, magnified.

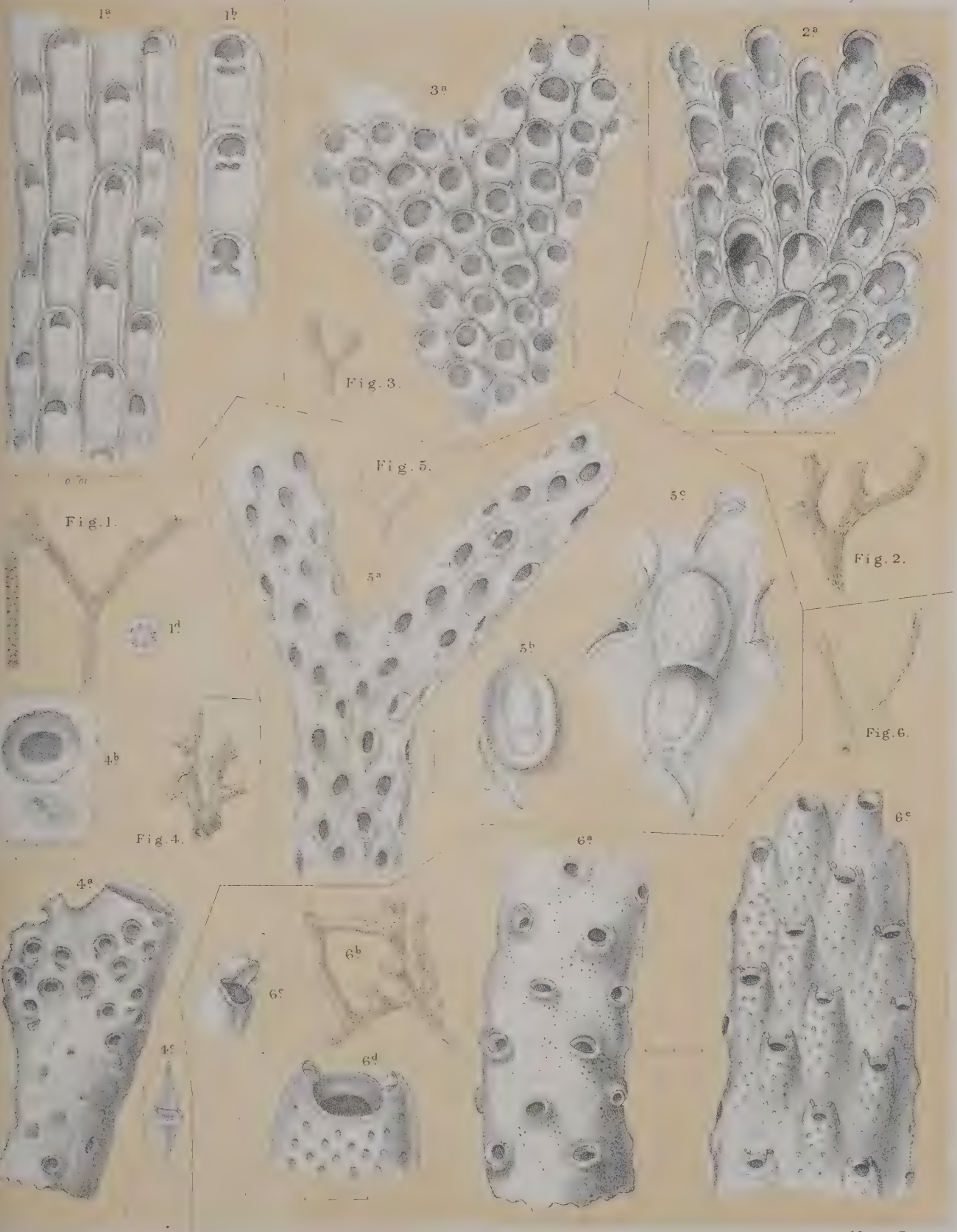
„ 3.—*Amphiblestrum capense*,* 67
3*a*, magnified.

„ 4.—*Foveolaria orbicularis*, ... 68
4*a*, magnified; 4*b*, orifice; 4*c*, avicularium, more highly magnified.

„ 5.—*Foveolaria elliptica*, ... 68
5*a*, magnified; 5*b*, 5*c*, oœcium and avicularia.

„ 6.—*Myriozoum marionense*, ... 171
6*a*, magnified; 6*b*, ramose variety; 6*c*, younger portion of the zoarium; 6*d*, single zoœcium; 6*e*, oral avicularium, more highly magnified.

[1] The species thus marked (*) have been re-named since the plate was printed off.



C B del C Berjeau lith

Mintern Bros. imp.

1. VINCULARIA GOTHICA. 2. V. MAGNILABRIS. 3. V. CAPENSIS.
4. FOVEOLARIA ORBICULARIS. 5. F. ELLIPTICA. 6. MYRIOZOUM MARIONENSE.

PLATE XXIV.

PLATE XXIV.[1]

TURRITIGERA.—RETEPORELLA.—BIFAXARIA.—HASWELLIA, &c.

PAGE

Figure 1A.—*Turritigera stellata*, ... 130
1B, orifice with columnar processes; 1C, 1E, avicularia; 1D, dorsal opening with young Crinoid issuing from it; 1F, orifice with avicularian process; 1G, back view.

„ 2A.—*Reteporella myriozoides*, ... 127
2B, magnified; 2C, orifice and avicularium.

„ 3A.—*Bifaxaria denticulata*, ... 82
3B, magnified; 3C, avicularia.

„ 4A.—*Bifaxaria papillata* (Pl. XIII. fig. 4), ... 81
4B, 4C, magnified; 4D, showing papilliform avicularium.

„ 5A.—*Bifaxaria abyssicola*, ... 82
5B, magnified; 5C, 5D, lateral aspect; 5E, transverse section of the zoarium, showing the position of the zoœcia and avicularia.

„ 6.—*Bifaxaria corrugata*, showing papilliform avicularia (Pl. XIII. fig. 3), ... 80

„ 7A.—*Tubucellaria opuntioides* * (Pl. XXXVI. fig. 19), . . . 100
7B, magnified; 7C, orifice, more highly magnified.

„ 8A, 8B.—*Tessaradoma boreale*, ... 174
8C, magnified; 8D, more highly magnified; 8E, showing median pore with *Rotalina* attached.

„ 9A.—*Haswellia australiensis*, ... 172
9B, magnified; 9C, 9D, 9F, 9G, orifices at various stages; 9H, transverse section.

„ 10A.—*Haswellia auriculata*,* 173
10B, 10C, older part of zoarium and orifices; 10D, oœcium; 10E, primary orifice with emarginate lower border.

[1] The species thus marked (*) have been re-named since the plate was printed off.

del. C. Berjeau lith.

Mintern Bros. imp.

1. TURRITIGERA STELLATA. 2. RETEPORA MYRIOZOIDES. 3. BIFAXARIA DENTICULATA.
4. B. PAPILLATA. 5. B. ABYSSICOLA. 6. B. CORRUGATA. 7. TUBUCELLARIA CEREOIDES (*var.*)
8. TESSARADOMA BOREALE 9. T. VERTICILLATUM. 10. T. AURICULATUM.

PLATE XXV.

PLATE XXV.

MYRIOZOUM.—GEMELLIPORA.—RETEPORELLA.—RETEPORA.

PAGE

Figure 1.—*Myriozoum simplex*, ... 170
1*a*, magnified; 1*c*, orifice in the younger part; 1*d*, orifice in older part.

„ 2.—*Myriozoum honolulense*, ... 170
2*a*, magnified; 2*b*, transverse section; 2*c*, lateral wall of zoœcium.

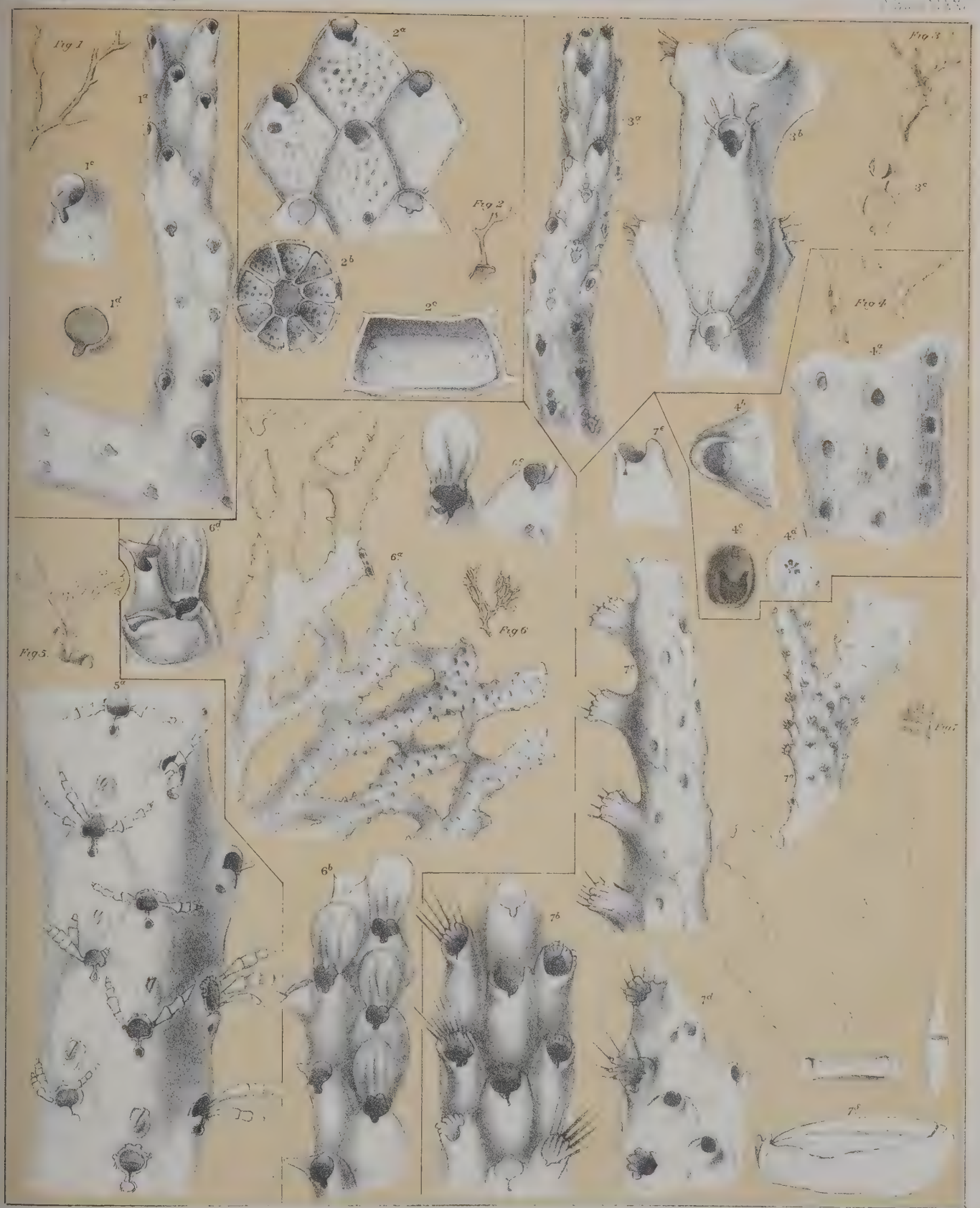
„ 3.—*Gemellipora glabra*, ... 176
3*a*, magnified; 3*b*, more highly magnified; 3*c*, orifice and avicularium.

„ 4.—*Myriozoum immersum*, ... 170
4*a*, magnified; 4*b*, orifice; 4*c*, orifice viewed from above; 4*d*, transverse section.

„ 5.—*Reteporella flabellata*, ... 126
5*a*, magnified.

„ 6.—*Retepora apiculata*, ... 108
6*a*, magnified; 6*b*, with oœcia; 6*c*, more highly magnified.

„ 7.—*Retepora producta*, ... 108
7*a*, magnified; 7*b*, 7*c*, 7*d*, different views, more highly magnified; 7*e*, primary orifice; 7*f*, avicularium.



C.b del. G.West Jun.r lith.

Stanhart imp

1. TESSARADOMA SIMPLEX. 2. MYRIAZOUM HONOLULENSE. 3. M. GLABRUM.
4. M. IMMERSUM. 5. RETEPORA FLABELLATA. 6. R. APICULATA. 7. R. PRODUCTA.

PLATE XXVI.

PLATE XXVI.

Retepora.

PAGE

Figure 1*a*.—*Retepora denticulata*, ... 109
1*b*, more highly magnified; 1*c*, 1*d*, avicularia.

„ 2*a*.—*Retepora contortuplicata*, ... 120
2*b*, more highly magnified.

„ 3*a*.—*Retepora delicatula*, ... 125
3*b*, 3*c*, more highly magnified; 3*d*, mandible of fenestral avicularium.

„ 4*a*.—*Retepora hirsuta*, ... 119
4*b*, more highly magnified; 4*c*, oœcium with trifoliate stigma; 4*d*, 4*e*, avicularia; 4*f*, 4*g*, antenniform spines.

„ 5*a*.—*Retepora columnifera*, ... 122
5*b*, zoœcia more highly magnified; 5*c*, columnar avicularium; 5*d*, 5*e*, fenestral avicularium and mandible.

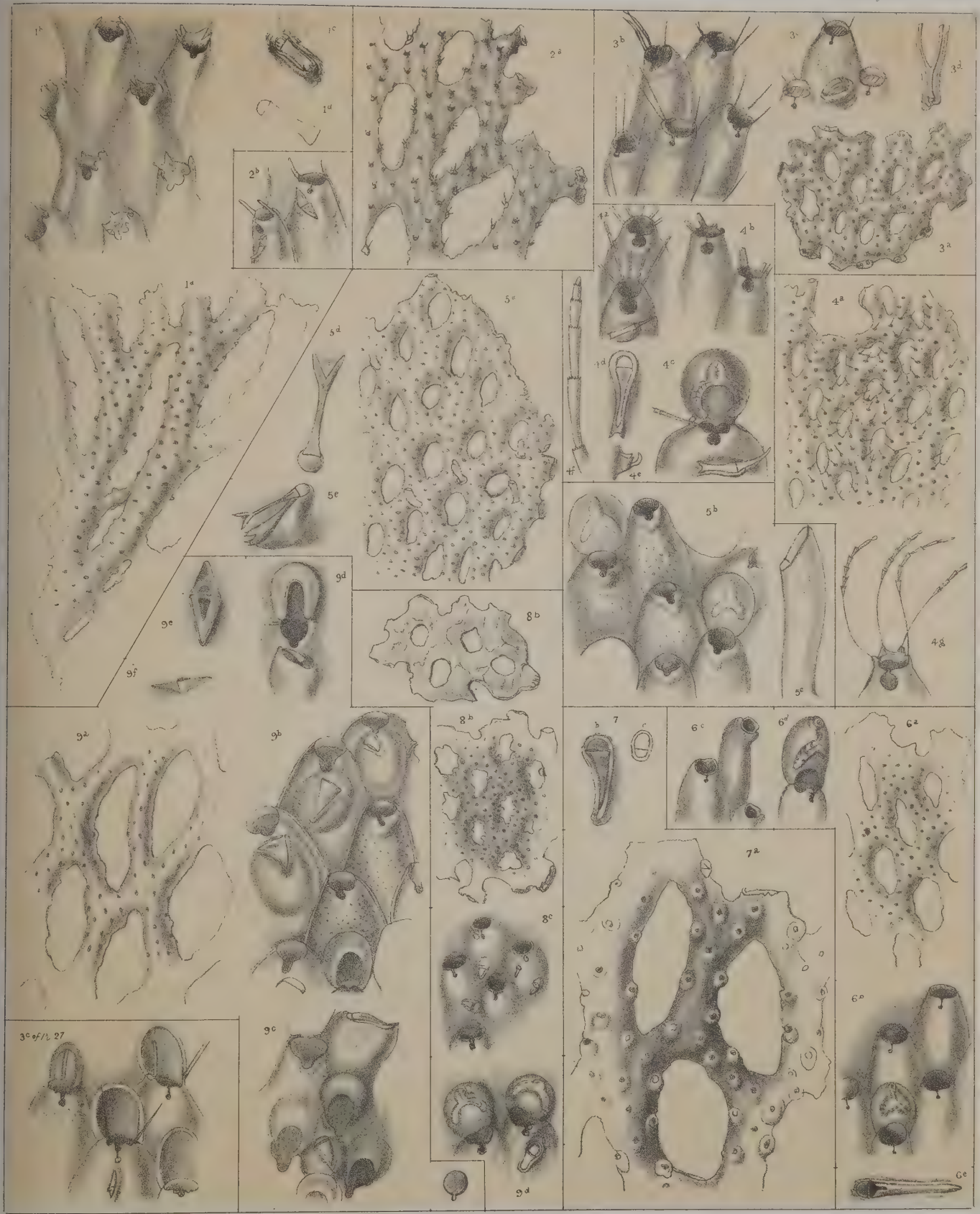
„ 6*a*.—*Retepora mucronata*, ... 120
6*b*, zoœcia more highly magnified; 6*c*, orifices with pyramidal mucro; 6*d*, oœcium.

„ 7*a*.—*Retepora gigantea*, ... 114
7*b*, 7*c*, avicularia.

„ 8*b*.—*Retepora cavernosa*, ... 121
8*c*, magnified; 8*d*, oœcia.

„ 9*a*.—*Retepora imperati*, ... 110
9*b*, zoœcia, magnified; 9*c*, oœcia; 9*d*, 9*e*, 9*f*, avicularia.

„ 10.—*Retepora crassa*, oœcia (Pl. XXVII. fig. 3), . . . 115



C.F.del Purkiss lith

Hanhart imp

1. RETEPORA DENTICULATA
2. " CONTORTUPLICATA.
3. " DELICATULA.
4. " HIRSUTA.
5. RETEPORA COLUMNIFERA.
6. " MUCRONATA.
7. " GIGANTEA.
8. CAVERNOSA.
9. RETEPORA IMPERATI.

PLATE XXVII.

PLATE XXVII.

Retepora.

PAGE

Figure 1.—*Retepora lata*, ... 115
1*a*, magnified.

„ 2.—*Retepora margaritacea*, ... 125
2*a*, 2*b*, showing the two kinds of avicularia.

„ 3.—*Retepora crassa* (Pl. XXVI. fig. 10), ... 115
3*b*, magnified.

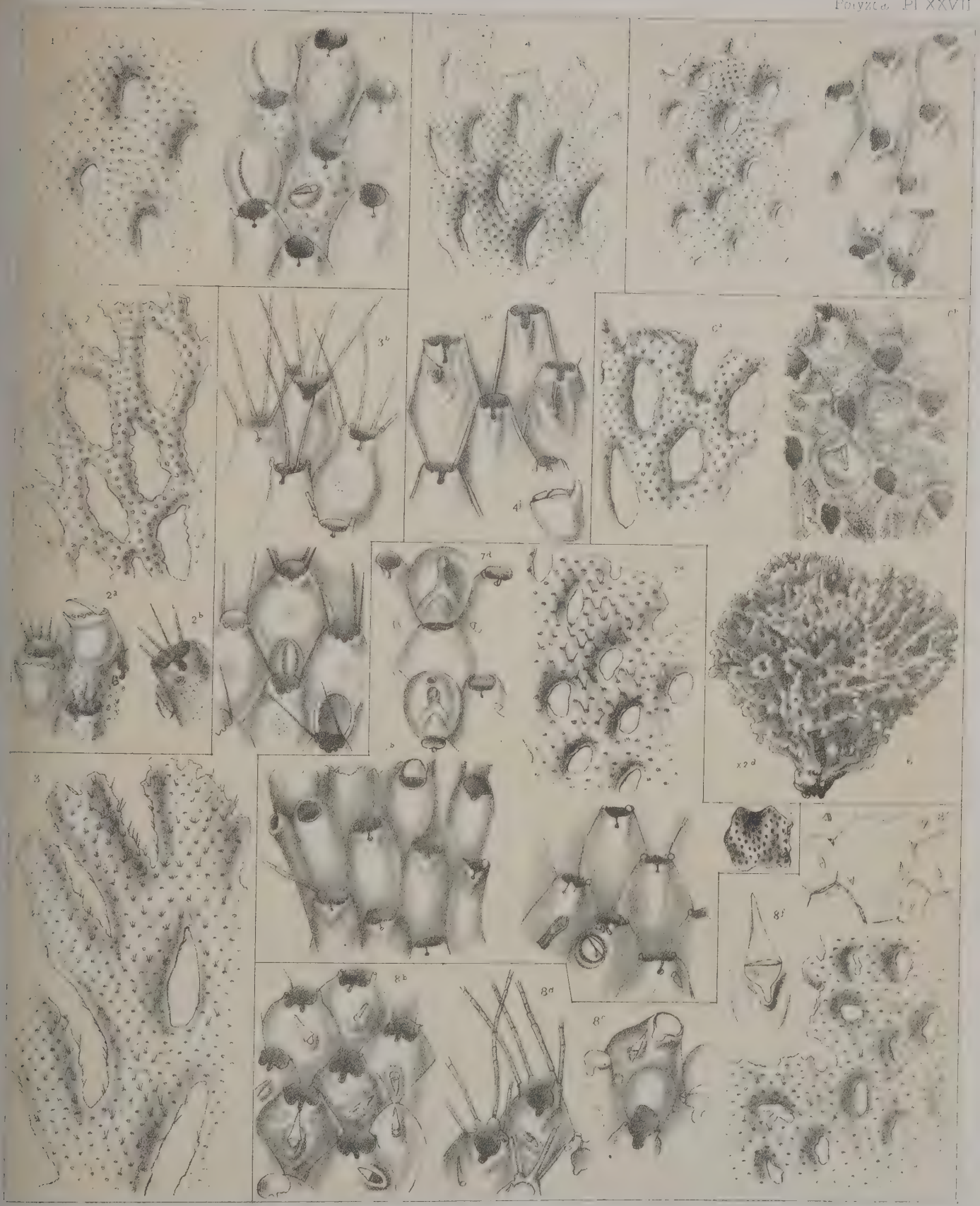
„ 4.—*Retepora jacksoniensis*, ... 125
4*a*, magnified; 4*b*, rostral avicularium.

„ 5.—*Retepora philippinensis*, ... 123
5*a*, magnified; oœcia shown below.

„ 6.—*Retepora tessellata*, var. *cæspitosa*, ... 113
6*a*, magnified; 6*b*, zoœcia, more highly magnified.

„ 7.—*Retepora victoriensis*, ... 117
7*a*, magnified; 7*b*, more highly magnified; 7*c*, various avicularia; 7*d*, oœcia.

„ 8.—*Retepora tessellata*, ... 112
8*b*, magnified; 8*c*, oœcium; 8*d*, oral spines of the younger zoœcia; 8*e*, dorsal surface; 8*f*, rostriform avicularium.



1. RETEPORA LATA
2. " MARGARITACEA
3 " CRASSA
4 " JACKSONIENSIS
5. RETEPORA PHILIPPINENSIS.
6 " CŒSPITOSA
7. " VICTORIENSIS.
8. " TESSELATA.

PLATE XXVIII.

PLATE XXVIII.[1]

RETEPORA.—CELLEPORA.—CHLIDONIA.

PAGE

Figure 1.—*Retepora atlantica*,* 116
1*a*, magnified; 1*b*, œcium.

„ 2.—*Retepora tubulata*, ... 121
2*a*, 2*b*, magnified.

„ 3.—*Retepora tessellata*, var. *pubens*, ... 113
3*a*, magnified; 3*b*, 3*c*, avicularia.

„ 4.—*Retepora simplex*, ... 118
4*a*, magnified.

„ 5.—*Cellepora ovalis* (Pl. XXXV. fig. 6), ... 202
5*a*, magnified.

„ 6.—*Cellepora aspera* (Pl. XXXV. fig. 2), ... 194
6*a*, magnified; 6*b*, avicularium.

„ 7.—*Cellepora rudis* (Pl. XXXVI. fig. 7), ... 199
7*a*, magnified; 7*b*, œcium; 7*c*, avicularium.

„ 8.—*Cellepora pustulata*, ... 200
8*a*, orifice;[2] 8*b*, orifice with avicularia; 8*c*, magnified; 8*d*, avicularium.

„ 9.—*Cellepora tuberculata* (Pl. XXXV. fig. 7), ... 193
9*a*, magnified.

„ 10.—*Cellepora conica*, also (Pl. XXXVI. fig. 1),* 203
10*a*, orifice; 10*b*, avicularium; 10*c*, œcium; 10*d*, avicularium.

„ 11.—*Chlidonia cordieri*, ... 8

[1] The species thus marked (*) have been re-named since the plate was printed off.

[2] 8*a* is the bottom left-hand figure.

GB & P del Purkiss lith

dampart imp

1. RETEPORA CELLULOSA.
2 „ TUBULATA.
3. „ PUBENS.
4 „ SIMPLEX.
5. CELLEPORA OVALIS
6. „ SIMONENSIS
7. „ RUDIS.
8. CELLEPORA PUSTULATA.
9. „ TUBERCULATA
10 „ CONICA.
11. CHLIDONIA CORDIERI.

PLATE XXIX.

PLATE XXIX.

Cellepora.

PAGE

Figure 1.—*Cellepora hastigera* (Pl. XXXV. fig. 8), ... 192
1*a*, avicularium; 1*b*, avicularium with obtuse mandible and bifid beak.

„ 2.—*Cellepora apiculata* (Pl. XXXV. fig. 12), ... 196

„ 3.—*Cellepora tridenticulata* (Pl. XXXV. fig. 17), ... 198
3*a*, orifice with oral spines; 3*b*, avicularium.

„ 4, 6, 8.—*Cellepora eatonensis* (Pl. XXXVI. fig. 5), ... 201
4*a*, 4*b*, avicularia; 6*a*, orifice enlarged; 6*b*, part view of orifice; 6*c*, 6*d*, avicularia; 8*a*, front view of orifice; 8*b*, avicularium; 8*c*, one of the interspersed avicularia.

„ 5.—*Cellepora honolulensis* (Pl. XXXV. fig. 15), ... 195

„ 7.—*Cellepora imbellis* (Pl. XXXV. fig. 20), ... 195

„ 9.—*Cellepora simonensis* (Pl. XXXVI. fig. 8), ... 200
9*a*, operculum.

„ 10.—*Cellepora vagans* (Pl. XXXV. fig. 11), ... 198
10*a*, zoœcium; 10*b*, avicularium; 10*c*, 10*d*, larger avicularia; 10*e*, operculum.

„ 11.—*Cellepora columnaris* (Pl. XXXV. fig. 16), ... 194

„ 12.—*Cellepora solida*, ... 200
12*a*, operculum.

Fig. 1

Fig. 2.

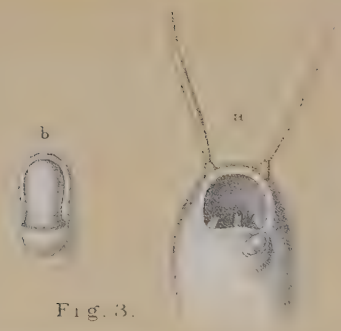


Fig. 3.

Fig. 4.

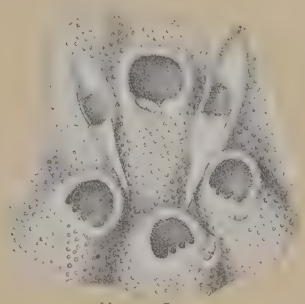


Fig. 5

Fig. 6

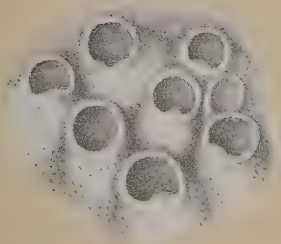


Fig. 7.

Fig. 8.

Fig. 9.

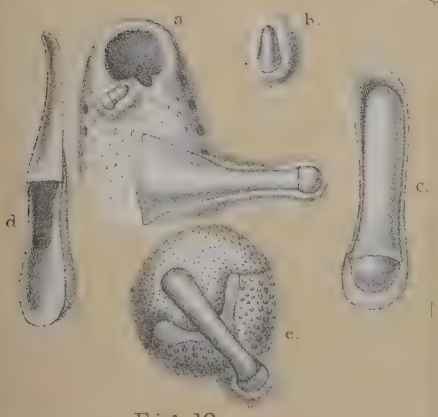


Fig. 10.

Fig. 11.

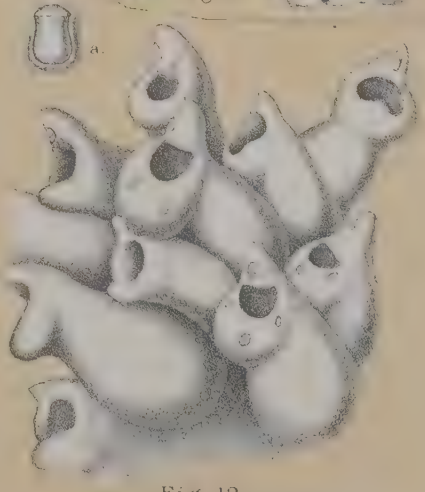


Fig. 12.

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1. CELLEPORA HASTIGERA. 2. C. APICULATA. 3. C. TRIDENTICULATA.
4. C. EATONENSIS. 5. C. HONOLULENSIS. 6. C. EATONENSIS. 7. C. IMBELLIS.
8. C. EATONENSIS. 9. C. SIMONENSIS. 10. C. VAGANS. 11. C. COLUMNARIS. 12. C. SOLIDA.

PLATE XXX.

PLATE XXX.

Cellepora.

PAGE

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,, 4.—*Cellepora ansata* (Pl. XXXVI. fig. 17), . . . 204
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,, 5.—*Cellepora canaliculata* (Pl. XXXVI. fig. 16), . . . 204
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,, 6.—*Cellepora bidenticulata* (Pl. XXXVI. fig. 6), . . . 204
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,, 7.—*Cellepora samboangensis* (Pl. XXXV. fig. 10), . . . 196

,, 8.—*Cellepora discoidea* (Pl. XXXV. fig. 1), . . . 197
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,, 9.—*Cellepora cylindriformis* (Pl. XXXVI. fig. 9), . . . 201
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,, 10.—*Cellepora jacksoniensis* (Pl. XXXV. fig. 9), . . . 195
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,, 11.—*Cellepora polymorpha* (Pl. XXXV. fig. 19), . . . 195
11*a*, orifice; 11*b*, side view; 11*c*, oœcium; 11*d*, avicularium.

Fig. 1

Fig. 2

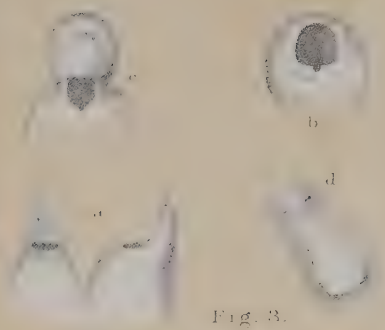

Fig. 3.

Fig. 4.

Fig. 5.

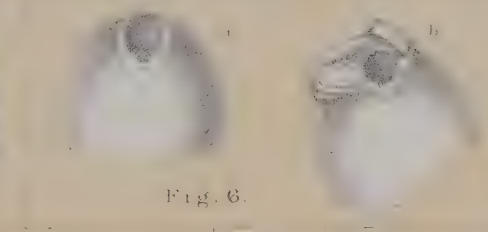

Fig. 6.

Fig. 9

Fig. 8.

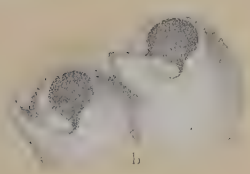

Fig. 7.

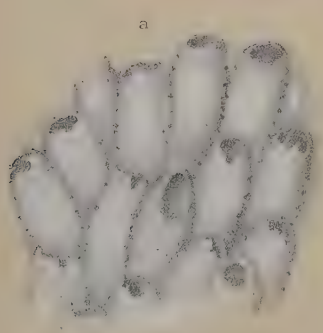

Fig. 10.

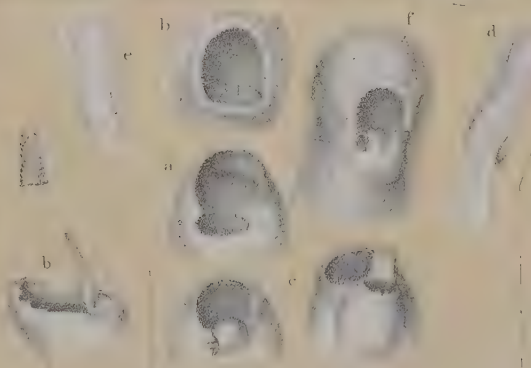

Fig. 11.

Fig. 12

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1. CELLEPORA BICORNIS. 2. C. BILABIATA. 3. C. SIGNATA. 4. C. ANSATA.
5. C. CANALICULATA. 6. C. BIDENTICULATA. 7. C. ZAMBOANGENSIS. 8. C. DISCOIDEA.
9. C. CYLINDRIFORMIS. 10. C. JACKSONIENSIS. 11. C. POLYMORPHA. 12. C. BICORNIS.

PLATE XXXI.

PLATE XXXI.

Farciminaria.—Bugula.

PAGE

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„ 2.—*Farciminaria brasiliensis*, ... 50
2*a*, magnified; 2*b*, oœcium, more highly magnified.

„ 3.—*Farciminaria hexagona* (Pl. XIV. fig. 10), ... 51
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„ 4.—*Farciminaria pacifica*, ... 50
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„ 5.—*Farciminaria delicatissima*, ... 51
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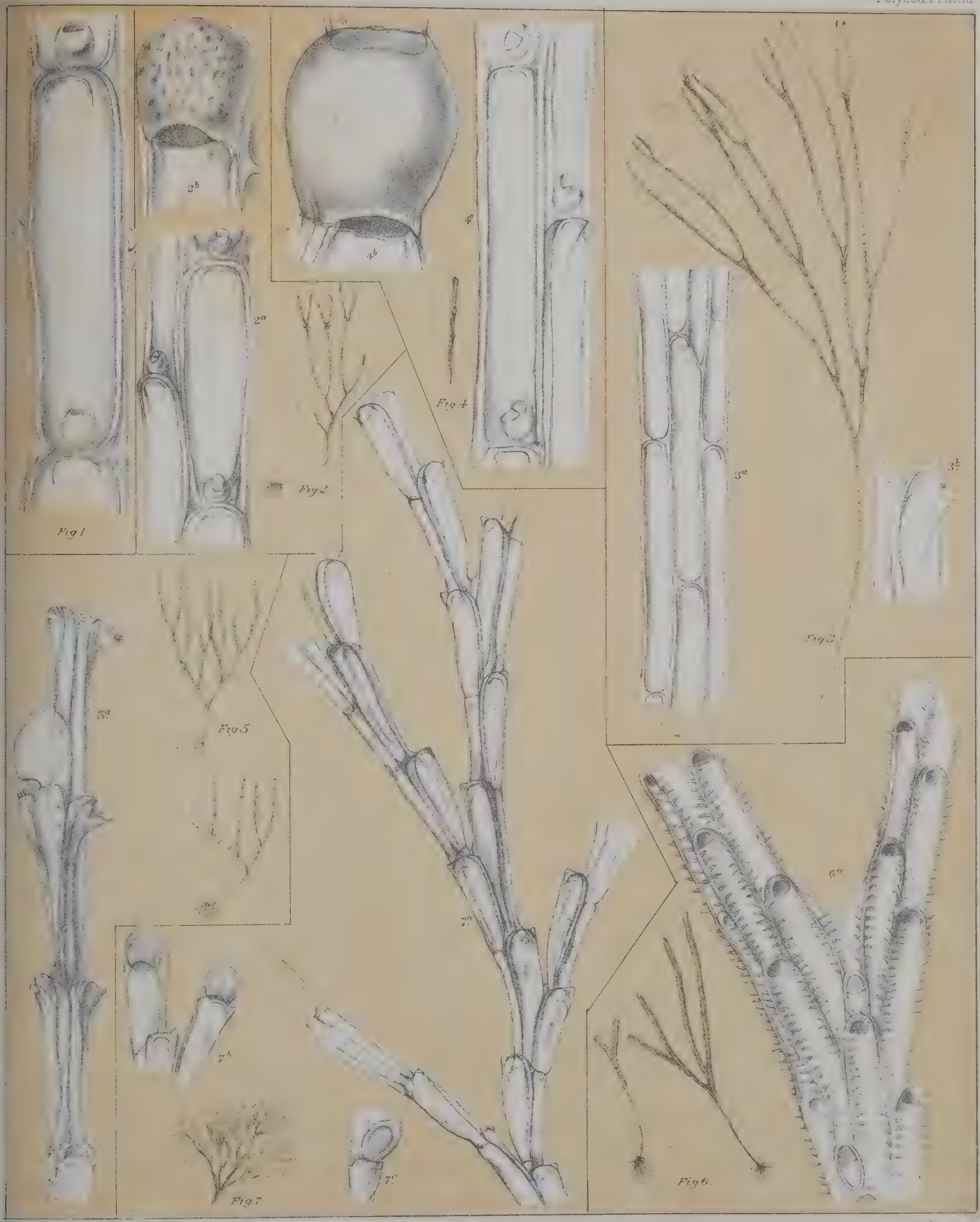
„ 6.—*Farciminaria atlantica*, ... 49
6*a*, magnified.

„ 7.—*Bugula longissima*, ... 42
7*a*, magnified; 7*b*, 7*c*, oœcia.



..Bdel G.West, lith Edin.h

1.FARCIMINARIA MAGNA *var* ARMATA. 2.F.BRASILIENSIS. 3.F.HEXAGONA.
4.F. PACIFICA. 5. F. DELICATISSIMA. 6. F. ATLANTICA. 7. BUGULA LONGISSIMA.

PLATE XXXII.

PLATE XXXII.

BICELLARIA.—FLUSTRA.—CALYMMOPHORA.—CABEREA.

PAGE

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„ 3.—*Calymmophora lucida*, ... 83
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„ 4.—*Caberea rostrata*, ... 28
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„ 5.—*Caberea minima*, ... 30
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„ 6.—*Caberea darwinii*, ... 29
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„ 7.—*Flustra membraniporides*, ... 54
7*a*, natural size; 7*b*, magnified.

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1. BICELLARIA MACILENTA.
2. FLUSTRA DENTICULATA.
3. CALYMOPHORA LUCIDA.
4. CABEREA ROSTRATA.
5. " MINIMA.
6. " DARWINII.
7. FLUSTRA MEMBRANIPORIDES.

PLATE XXXIII.

PLATE XXXIII.[1]

AMPHIBLESTRUM.—ELECTRA.—ASPIDOSTOMA.—CARBASEA, &c.

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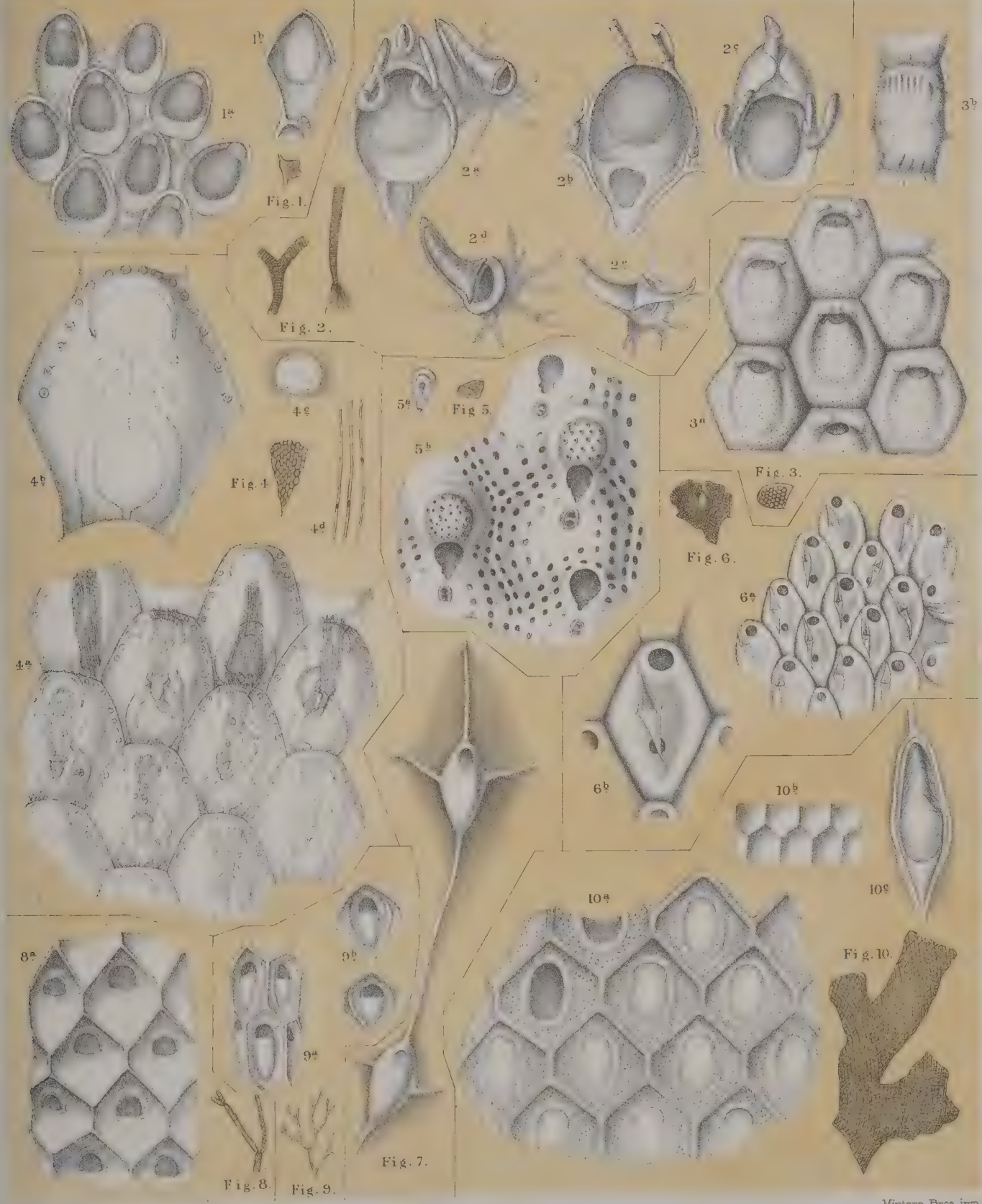
[1] The species thus marked (*) have been re-named since the plate was printed off.

[2] See footnote on page 78 of text.



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1. MEMBRANIPORA PAPILLATA. 2. ELECTRA CYLINDRICA. 3. ASPIDOSTOMA GIGANTEA.
4. CARBASEA MOSELEYI. 5. LEPRALIA CRIBRITHECA. 6. ADEONA GRISEA.
7. HIPPOTHOA FLAGELLUM. 8. SALICORNARIA SIMPLEX. 9.5. BICORNIS. 10. VINCULARIA RHOMBICA.

PLATE XXXIV.

PLATE XXXIV.

PASYTHEA.—GEPHYROPHORA.—BRETTIA.—DIACHORIS, &c.

PAGE

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„ 5.—*Phylactella*, sp. (?), fragment from Station 253, 3125 fathoms (not noticed in the text).

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1. PASYTHEA EBURNEA. 2. GEPHYROPHORA POLYMORPHA. 3. BRETTIA AUSTRALIS.
4. DIACHORIS COSTATA. 5. PHYLACTELLA SP ? 6 " CORNIGERA.
7. CELLEPORA ALBIROSTRIS. 8. CARBASEA CRIBRIFORMIS.

PLATE XXXV.

PLATE XXXV.

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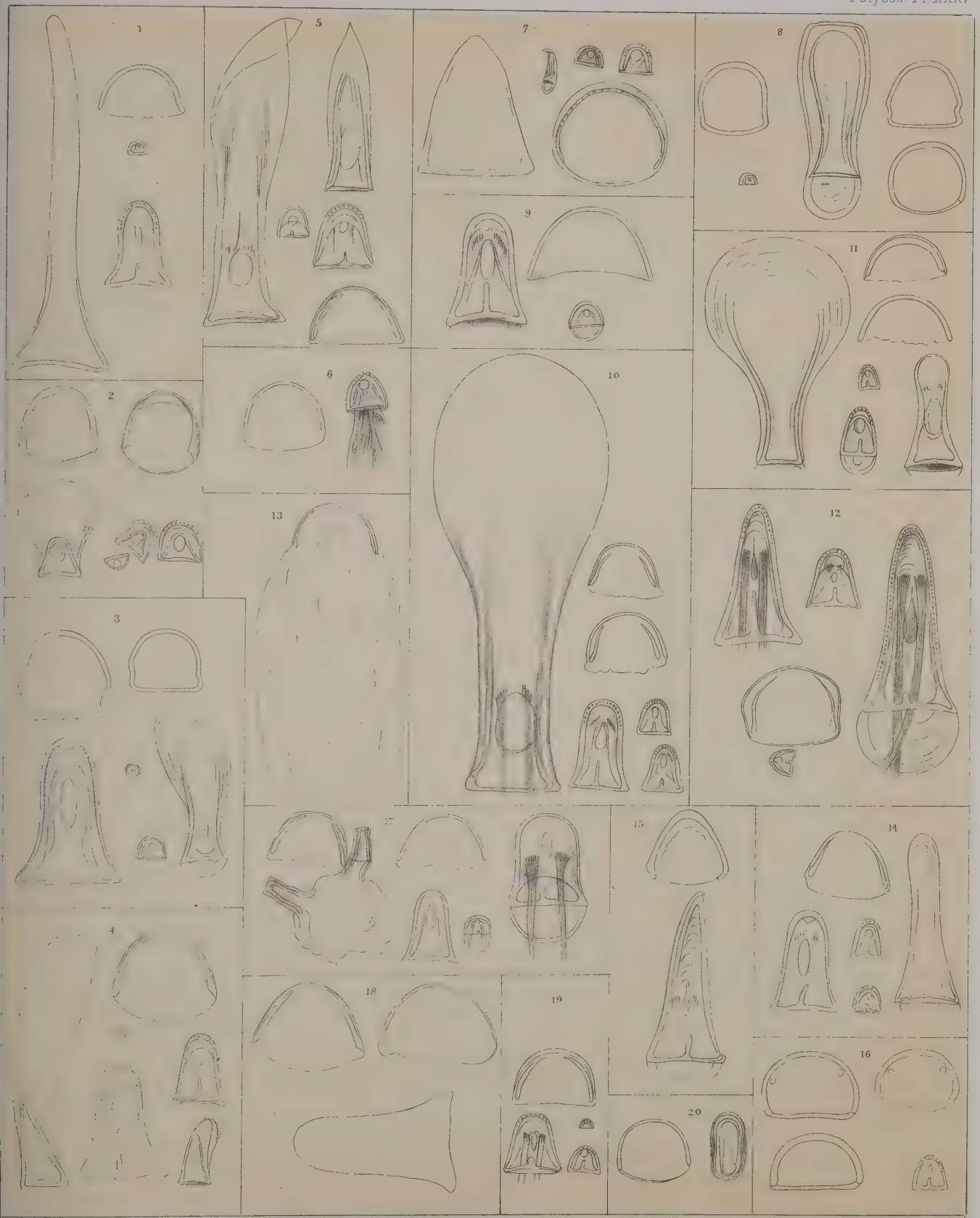

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CHITINOUS APPENDAGES OF SPECIES OF CELLEPORA.

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PLATE XXXVI.

PLATE XXXVI.

CELLEPORA (CHITINOUS APPENDAGES).—TUBUCELLARIA.—RETEPORA.

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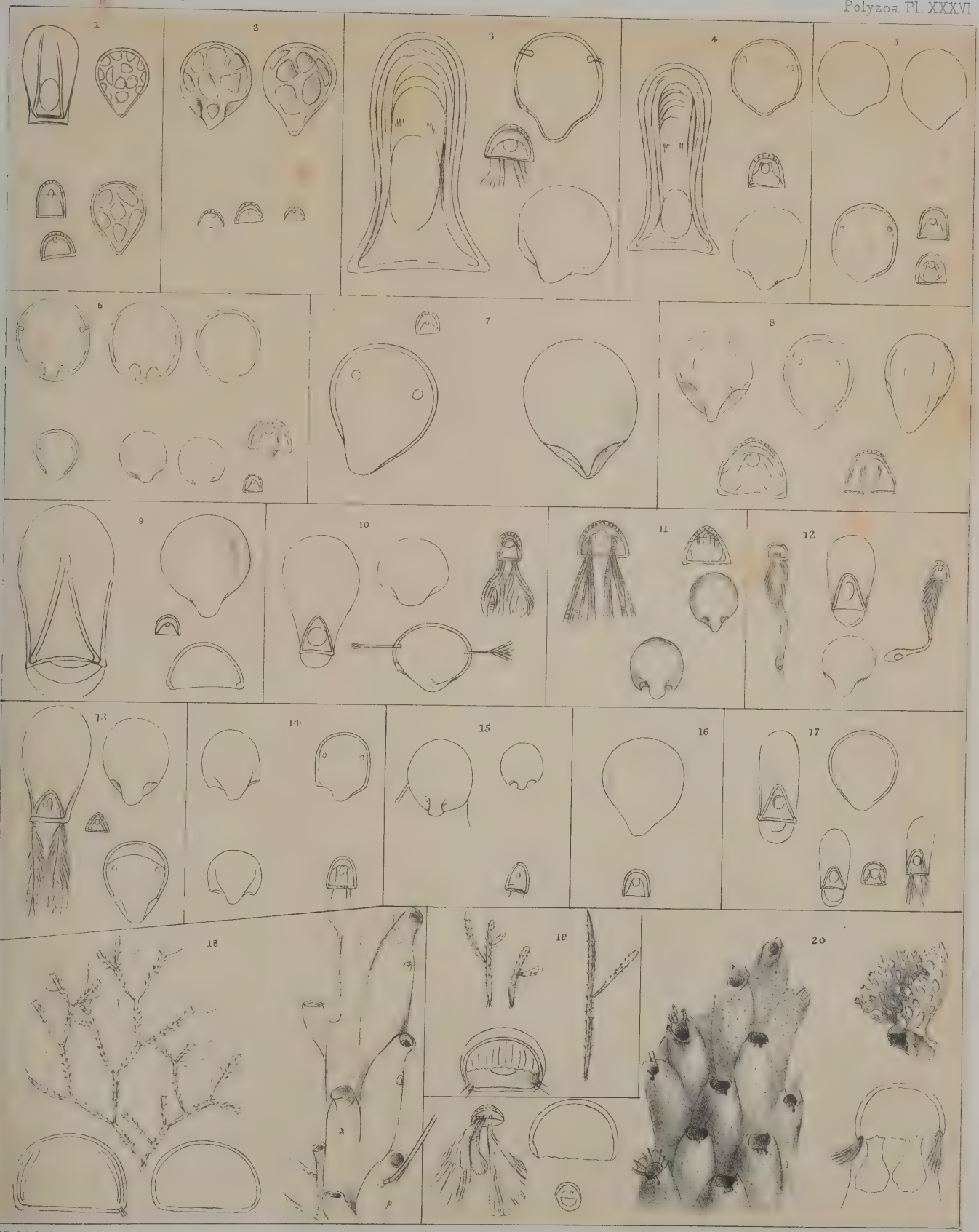
„ 20.—*Retepora magellensis*, natural size; zoœcia magnified, and chitinous parts, ... 126



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1.17. CHITINOUS APPENDAGES OF SPECIES OF CELLEPORA.
18. TUBUCELLARIA.
19. ,, CEREOIDES.
20. RETEPORA MAGELLENSIS.

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